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PILOTAGE IN THE PORT OF NEW YORK

FINAL REPORT

JULY 1978

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16. Abstract The report presents the results of a study of pilotage in the Port of New York. A major goal was to identify pilotage information, its source, the way it is used, and how it relates to the pilots' command orders. Seventeen transits in six areas of the harbor were recorded on video tape. In edited form they provide more than 24 hours of detailed descriptions of piloting events. Discussions are presented of the navigation problems in the major harbor areas and the types of information the pilots use for their maneuvering decisions.

It was concluded that three interacting sources of information form the basis for the decision process: local knowledge, transit specific information, and knowledge of shiphandling. His local knowledge permits the pilot to maintain orientation, fix position, and anticipate dynamic characteristics of the environment. Transit specific information builds before and during the transit and is a source of information about the dynamics of the environment, the ship, and their interactions. Shiphandling knowledge serves as a background for most order decisions.

It was concluded that there are five basic conning positions that have important implications for navigation and bridge design and layout.

It was concluded that technical advances in propulsion control are not being fully utilized to meet the navigation requirements in pilotage.

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PILOTAGE IN THE PORT OF NEW YORK

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and Graduate Studies
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July 1978

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Prepared for:

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PREFACE

Typically field studies of the type reported here are possible only with the generous cooperation of many people and organizations. The author accumulated an enormous number of debts to professional organizations, colleagues and friends who gave generously of their ideas, knowledge and time. This preface is devoted to the acknowledgement of some of these debts.

The requirement for the study originated in the U. S. Coast Guard Office of Research and Development, Safety and Advanced Technology Division. Many useful contributions were made by Commander Warren Snider. Lt. Commander Larry Olson and Mr. D. Todd Jones, serving successively as the Office's technical monitors, provided important guidance throughout the project and during the preparation of the report.

Much of the success of the project belongs to the administrative staff and faculty of the Maritime Institute of Technology and Graduate Studies. Particular recognition is due Mr. Max H. Carpenter, Executive Director, who exhibits a rare sense of appreciation for the long-term value of research for the Maritime Industry and who gave unfailing support and encouragement to the program. To Mr. John K. Bobb, Deputy Director, and Mr. John A. Gorman, Finance Officer, who willingly added the many contract administration problems to already busy work schedules. To Captain Wayne M. Waldo, Head of the Navigation Department, who provided many subtle inputs that often served to focus attention on significant items that would have otherwise gone unnoticed. To Ms. Jo Ann Funk, Administrative Secretary, whose competent production assistance under pressing deadlines was always cheerfully given.

A special note of appreciation is reserved for Mr. Lee Klima, Head of the Media Resources Center, MITAGS, who assumed the major responsibility for the video productions. His skill and expertise in the medium were frequently tested in the unorthodox environment of the navigation bridge and never found wanting. He is equally skillful in the editing studio. In these important ways he shares authorship for the study.

Special gratitude must be given to all the officers and members of the pilot groups who contributed their unique professional knowledge in so many generous and cooperative ways: The Sandy Hook Pilots Association; The Association of Maryland Pilots; The Virginia Pilots Association; The Panama Canal Pilots; The Delaware Pilots Association.

The understanding reflected in the report on the role of the docking master and the tugboat in maneuvering ships in and around the docks, must be credited to the generous cooperation of the officers, pilots and mates of McAllister Brothers, Inc., Moran Towing and Transportation Co., Inc. and Redstar Marine Services, Inc.

Finally, a debt of gratitude must be extended to the steamship companies and their masters who graciously gave their permission for the investigators to sail on the bridge of their vessels. Without their management's foresight and understanding that such studies can ultimately benefit the entire Marine Industry the study could not have been made.

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REPORT SUMMARY

PURPOSE OF THE STUDY

Information is presented in this report that provides an understanding of pilotage practices and procedures in the Port of New York. A major purpose of the investigation was to identify the information used by the pilots, its source, the way it is used, and how the information relates to the pilot's command orders.

STUDY METHODS

For the purpose of collecting pilotage date, a series of ship and tugboat/barge transits were made with professional pilots in the Port of New York. A total of seventeen of these transits were recorded using video/audio equipment. These recordings provide the viewer information about pilotage practices and procedures in six major areas of the Port. In their edited form, they represent more than twenty-four (24) hours of transit-related information. During the transits the pilots provided detailed descriptions of the significant piloting events as they occurred and the information they were using to identify and resolve potential or actual problems. Written summaries of the transits with editorial comments are provided in Appendix A of the report.

FINDINGS

Pilotage as performed by the professional pilot in the Port of New York is largely a visually dependent activity involving a continuous series of actions and reactions to the transit situation.

Three classes of interacting sources of information form the basis for the decision process involved in directing vessel movements: Local knowledge; transit specific information; and knowledge of shiphandling techniques. Local knowledge exist in the long term memory of the pilot and is subject to recall on demand and/or by situational factors. This information is characterized generally as being of the type that appears on the nautical charts prepared for the area and in the memory of professional pilots who regularly work in the area. It is the local knowledge that permits the pilot to continuously maintain his orientation and accurately fix his vessel's position, and to anticipate many of the dynamic characteristics of the environment.

Transit specific information is that which the pilot accumulates before and during a particular transit. It includes information about the actual dynamic characteristics of the environment, the ship and their interactions under the conditions of a specific transit.

Shiphandling knowledge serves as a background for most order decisions and is generally thought to be of less importance in the decision process than either local knowledge or transit specific information.

Observations suggest that the detail and accuracy of a pilot's local knowledge, and the types of transit specific information he acquires and the way he acquires it, are importantly related, both separately and in their interactions, to the quality of the decision process. It seems likely that errors from either or both sources can contribute to undesirable performance, that can often be confusingly labeled as shiphandling errors. It is thereby proposed that research is needed to clarify the role of these information sources and their interactions in the maneuvering decision process. Such work can be expected to have important implications for accident investigations and training program development.

Observations tend to confirm the conclusions of other studies that pilots use five (5) basic conning positions for directing the movements of the vessel. Position #1 is located directly in front of the bridgehouse window on the centerline of the ship. Positions #2 and #3 are located to the left and right of position #1, respectively, with the exact location of each dependent on obtaining an unobstructed view forward. Positions #4 and #5 are located on the extreme ends of the port and starboard bridge wings, respectively. Each of these positions are importantly related to the pilot's navigational information requirements in various transit situations. The ability to identify these conning positions can serve as a useful aid in solving many otherwise difficult bridge design and instrumentation layout problems.

The characteristic methods of controlling the main propulsion plant and the attendant problems they present to the pilot when maneuvering in confined waters are described. It is generally concluded that the technological advances in propulsion control have not been fully or adequately utilized to provide the precision and greater reliability needed for the navigation of pilotage waters.

Descriptions of six major sections of the harbor are provided: Ambrose Channel; Upper Bay; "The Southway"; Arthur Kill; Kill Van Kull; Newark Bay. Included are discussions of the principle navigation problems for each of these areas and the types of information the pilots are generally using for their maneuvering decisions.

I. INTRODUCTION

In July 1976, the author concluded a preliminary investigation of pilotage practices in five major ports and waterways of the United States.[1] A primary purpose of the study was to assess the feasibility of collecting data useful in understanding the information pilots use in making maneuvering decisions and where this information comes from.

Two types of data collection procedures were used, with both being judged useful for the purposes of the study. The first involved informal conversations with the pilot while he was conning the vessel. These conversations focused on the piloting events of the transit, with the pilot explaining his actions, the reasons for the actions and the information being used for making the maneuvering decisions. The technique was judged to be very useful overall as an aid in understanding general piloting practices and procedures and for identifying the major sources of information being used by the pilot for his maneuvering decisions.

The second data collection technique used in the preliminary study called for the pilot to think out loud, in the presence of an audio recorder, while conning the vessel in a series of maneuvers. During these exercises the observer withdrew from any participation and tried to become as inconspicuous as possible. The idea was to have the pilot verbalize everything that comes to mind while performing the job. Properly used the technique provides the observers immediate feedback on what and where the concern and attention of the pilot is directed at any moment throughout the maneuver. Unlike the conversational technique, which tends to yield an after-the-maneuver rationalization of the events that occurred, the think aloud technique provides immediate

[1] "Pilotage in Confined Waterways of the United States: A Preliminary Study of Pilot Decision Making," Available through the National Technical Information Service, AD A029715, Springfield, VA 22151

information about the pilots' perceptions and interpretations of the situation as the events unfold. As the reader may have surmised, a pilot cooperating fully with the technique tends to lay bare for the tape recorder his perceptions of the situation, his analysis of the problems or potential problems and his techniques for dealing with them. Thus it was concluded that even though only one useful think aloud protocol was obtained during the preliminary study, the potential power of the technique justified its inclusion in the second study.

The data collection was initiated using audio tape recorders, a 35mm still camera and hand written logs. The camera was intended to help identify ship's position and other relevant information sources during important piloting events and the logs were to cover other needed data. Early in the data collection effort the camera and the written logs were assessed as being inadequate to the tasks and another approach had to be found. Attention was directed at the possibility of using video recording equipment. Video had the obvious advantage of correlating on one recording tape the visual and auditory data that was needed, assuming of course that the camera could be properly coordinated with the verbal data. A major consideration in its use involved the permissibility of such equipment on the navigation bridge of most commercial vessels. Opinions varied on this point, with most masters and pilots questioned answering that they would not object, however, they could understand the possible objections of others. After reasonable study of this and other associated problems, it seemed that the only way to work through the uncertainties was to procure some portable equipment and see what happened.

The Maritime Institute purchased a Sony 3400 "Video Rover" Porta-Pac System. This monochrome system utilized a one-half inch, reel to reel tape recorder and an inexpensive, 6-1 zoom, 12mm - 75mm for the camera.

The first attempt to take the equipment aboard ship was "vetoed" by a local pilot association on the grounds that ship masters would probably object to the presence of the gear on the bridge and that the two carrying cases, designed to protect the equipment from damage, were heavy, bulky and would put an undue burden on the ship's crew in getting the equipment on and off the vessels from the pilots' motor launches. Although there was some validity to these objections, and the study team appropriately honored them, it was also understood that other types of anxiety, on the part of the management of the pilot association, regarding the study purposes in general was being evidenced in the veto decision.

As the study team moved to other ports during the preliminary study, they learned to argue more eloquently for the need for the equipment and to capitalize on the natural interests and curiosity that most people evidenced in the video recording aspects of the study. They also learned that a major concern of some pilots and masters involved the disposition of the recording tapes in the event of an accident. (After all, this was a Coast Guard funded study.) This latter problem was dealt with by an unsolicited announcement that "in the unlikely event of an accident, all tapes recorded during the transit at once became the property of the ship to do with as the master determined." It was also observed that in case of an accident the tapes might just as likely serve to support the ship's actions as to argue against them. Although the relative merits of the approach and the various arguments used by the study team could not be sorted out as to their effectiveness, the desired results were obtained and the study team had no further difficulties (other than the physical labor involved) in taking the equipment aboard the ships and using it as intended.

Once in use the many advantages of video recording for the data collection became self evident: By keeping the camera generally focused ahead of the ship, its' track and position in the waterway could be established for later analysis.

Furthermore, the conversations and specific comments of the pilots were time related to the visual scene. The horizontal visual angle of the lens (from about 80° to 60°), a potential problem when the pilot was using information sources beyond the camera angle, was in part handled by having the operator monitor the pilot's comments and pan the camera to the subject of interest. In these instances the operator was usually able to move the camera in a way that retained a frame of reference associated with some physical aspect of the ship. When the location of the camera and recorder was beyond the direct verbal monitoring range of the pilot, the operator was able to listen to the pilot by way of an earplug that monitored the audio portion of the recorder. Still another advantage of the video equipment was the zoom lens on the camera. By using this characteristic the camera operator was able to improve on the visibility of distant objects. Finally, it was also recognized that the equipment could serve well as an effective note-taking method, far superior to pencil and paper logs.

There were some disadvantages associated with using the equipment. These, however, were considered to be minor in comparison with the benefits. The presence of video equipment on the bridge no doubt influences the behavior of everyone present, at least initially. But then so does the presence of audio recorders and/or observers. No obvious data exists from this study to permit an assessment of the impact of any of these intruders. Based on observer impressions, from a sizeable number of transits that varied from one observer with no equipment to two observers and full audio/video gear, it is concluded that the observers themselves are the greatest influence on the behavior of bridge personnel and the overall impact of the presence of equipment is much less than are observers initially, and fades much more rapidly as the transit proceeds.

The Porta-Pac also had some limitations. These included the lack of color, the reel to reel type tape transports, which are inferior to the cassette type for this work, and the one half inch tape it uses is not playable on the recorders most commonly available.

In addition to providing the opportunity to identify and solve many practical problems associated with this type of field study, the preliminary study also provided useful information about piloting practices and procedures in the five major ports visited. It was also established that a surprisingly large amount of the information used for maneuvering decisions in restricted waters is stored in the long term memory of the pilot. The ready availability of this detailed and comprehensive knowledge of the waterway and surroundings, from long term memory, permits the pilot to forego the traditional measuring, fixing, and plotting techniques associated with ship navigation and devote full-time attention to conning the vessel.

This report covers the follow-on work.

II. STUDY METHODS

A. Planning

Based on the experience of the preliminary study it was determined that the next phase effort should be confined to a single port, should extend and improve on the use and quality of the video/audio recording techniques, and should attempt to obtain high quality think out loud protocols.

The Port of New York was selected as the site for the study. A series of meetings were arranged with the Sandy Hook Pilots and three major towing companies: McAllister Brothers, Inc.; Moran Towing and Transportation Co., Inc.; Red Star Towing, Inc. The three towing companies do most of the tug assistance work in New York and several of their tugboat captains serve as docking pilots. The Sandy Hook Pilots do the bulk of the bar piloting for the port. All organizations cooperated generously throughout the study.

The full cooperation of the Sandy Hook Pilots and the towing companies was considered essential to the conduct of the study. Aside from the obvious considerations it had become clear during the earlier study that it was important to be able to meet with a pilot and acquaint him fully with the purposes of the study and the data collection procedures prior to the transit. During that part of the preliminary study that was done in New York, some pre-transit conversations had been possible with the bar pilots, but never with the docking pilots. Since the harbor configuration is such that tug assistance is required over significant areas, it was considered important to have direct access to both types of pilots.

Discussions with the bar pilots and docking masters, in conjunction with detailed studies of the nautical charts for the harbor, identified six major transit areas to be included in the study: Ambrose Channel and the Lower Bay; Sandy Hook Channel and Raritan Bay to Perth Amboy, N.J.; the Upper Bay; the Kill Van

Kull; Newark Bay; the Arthur Kill. Still other areas emerged as being of interest, e.g., the East River to Hell Gate and the Hudson River to the George Washington Bridge. However, it was clear from the discussions that the relatively light traffic on these routes would make scheduling difficult. As will be noted later, the several constraints involved in the scheduling process made it one of the most difficult problems encountered.

During the hiatus between the preliminary study and this second study, the Maritime Institute began to implement plans for developing a media resources center. These plans included the hiring of a professional person with extensive experience in video production to guide the center's development, and the procurement of several items of equipment that served as a windfall for the second phase of the study.

By the time data collection began, the original equipment (Sony Porta-Pac) had been upgraded to include a Sony DXC 1600 color camera with a F1.9, 10-1 zoom lens, 14mm to 140mm; the original AVC 3450 black/white camera, with the improved lens, a Sony VO 3800 color recorder, a 3/4" U-Matic Cassette, four Cine storage batteries that from full charge provide 4-5 hours of color recording; and a Sony 5" color monitor with both A/C and D/C power capability. In addition, two Sony VO 2850 recorders in combination with a TRI EA3 Outboard Editor was available for in-house editing. Equally important, the study program acquired the services (for data collection) of a professional video equipment operator who quickly learned the lessons from the earlier study and added improvements.

The procedures used in the preliminary study were reviewed and certain modifications were planned. For the most part these modifications were intended to illicit useable think out loud protocols, since the earlier procedures had worked adequately for the conversational technique. First, because it was recognized that not all pilots felt comfortable thinking aloud on the bridge, some way was needed to, either overcome the resistance on the part of the pilot, or to screen him out as a study participant. Three approaches were planned. One, spend as much time as possible in the Sandy Hook Pilot office and/or pilot boat meeting and talking with pilots about the study and procedures and noting those that evidenced a willingness to try the procedure. Second, try to schedule multiple transits with a pilot if he appeared willing to try the procedure. For the docking pilots the analogous approaches involved spending one or more days on the tugboat.

Another planned modification of the procedures was the post transit debriefings With the improved video equipment it became possible to easily show the recordings anywhere, the pilot boat, the tugboat, etc. This provided the opportunity to show the tapes of the transit to the pilot immediately afterwards and solicit further explanations and comments. The presence of two audio channels on the recording tape permitted the pilot to view the recorded transit, listen to his comments on one channel and record additional comments on the second channel.

B. Data Collection Procedures

1. Scheduling

Visits to New York for the purpose of taking data were coordinated in advance with officers of the organization involved, i.e., the Sandy Hook Pilots and/or the respective towing companies. The actual scheduling of ship transits varied with organizations being worked with, and included many factors beyond anyones direct control.

Transits with the bar pilots were scheduled through the Sandy Hook Pilot office located on Staten Island, or on the pilot boat located on station at the seabuoy. In all cases the initial transit with the bar pilots during a visit was scheduled in the pilot office following a review of the known ship assignments. Usually, these transits terminated at the seabuoy, with the inbound transit being arranged for from the pilot boat.

For transits made exclusively with docking pilots, the scheduling procedure included contacting the company office and the docking pilot, and arranging to spend one or more days aboard the docking pilot's tugboat. As the tug and pilot were assigned ship work, the observers arranged with the pilot and the ship's master for permission to accompany the pilot aboard the ship for the data collection. In one instance the study team accompanied docking pilots that worked out of their company office rather than from a tugboat.

Several factors interacted to complicate transit scheduling. First, ship movements in New York (and any port) are variable. Not even the pilots can accurately forecast the number of movements that are likely in relatively short time periods. Second, more than 100 bar pilots may be on the rotational call board at a time. A pilot is probably doing well if he can forecast his own transit schedules by plus or minus twelve hours. The dispatchers try to provide a pilot with a two hour advanced notice for ship assignment. This serves to permit the pilot to be prepared to move the ship at a certain time. Often, however, there are delays and cancellations, or sometimes it can suddenly appear that every ship in the port wishes to move at once. Third, the video equipment for practical purposes was unuseable during the hours of darkness. Thus, if a pilot selected for the study was assigned a night transit, he was essentially missed for that turn and the next three days or so. Fourth, some companies had refused permission to board their vessels. Thus, if a solicited pilot was assigned one of these vessels, he too was lost to the study for several days. Fifth, a tight data collection schedule called for a minimum of four transits per week. Finally, obtaining data on representative transit routes and in variable weather conditions was considered important. To the extent possible, both were taken into consideration in scheduling transits.

More discussion of these types of scheduling problems later.

2. Pre-Transit Briefings

Most pilots did superb jobs of explaining their actions. Thus the conversational data collection technique works well and useful information is almost always obtained. This is true, in the experience of this study, even when there has been little or no time to acquaint the pilot with the study prior to the transit. However, this happy situation did not exist in the case of the think out loud protocols. It was an event when a pilot seemed to understand what was being asked for and could comply fully. Since it was possible that most pilots needed more explanation of the technique than could be provided while the ship was underway, emphasis was put on pre-transit briefings. Because of the large number of bar pilots and the several other scheduling constraints, it was usually not possible to know more than two hours in advance the pilot for a particular transit and in most cases it was difficult to meet with him prior to boarding the ship. Consequently in the beginning, considerable time was spent in the pilot office briefing anyone who would listen, on the assumption that one of their turns might coincide with a data collection transit. It soon became clear, however, that far too much time was required and the potential payoff was too uncertain to pursue this approach. Attention was then returned to individual pre-transit briefings for the pilots who the team would ride with, whenever and wherever such briefings could be arranged. Some pilots, understanding the problem, agreed to come to the office early, or arranged meeting places enroute to the ship to receive the briefings.

When sailing primarily with the bar pilots, no opportunity existed to brief the docking pilot prior to the transit. However, when sailing primarily with the docking pilots, ample opportunity existed to talk with the docking pilots, on the tugboat, prior to boarding the ship.

3. Data Collection

Upon boarding the vessel, introductions were exchanged with the master and bridge crew; the observers explained their presence and purpose and otherwise set about to establish cooperative rapport with everyone. The purpose of video equipment was explained and often demonstrated. On foreign flag vessels in particular, the video was often a good "ice breaker". In a few instances masters questioned the presence of the video: "Suppose there is an accident?" The observers advised that in case of an accident, the tapes belonged to the ship to do with as they wished.

With the approval of the pilot and master, the video equipment was activated. In the event the pilot did not start providing information on his activities, the observer would initiate conversation calculated to elicit information relevant to the piloting events taking place. All pilots responded well to this approach and were clearly willing to provide whatever information they could in such conversations. Few pilots, however, demonstrated more than half-hearted attempts to think out loud even though they were asked to do so several times during each transit.

The procedures for using the video equipment that seemed best for our purposes involved the following: First, camera and recorder operations required the full time attention of one person. The camera operator monitored the conversation of the pilot, the observer and other bridge personnel and directed the camera accordingly. With the camera located in a remote portion of the bridgehouse, this is best done by monitoring via an earplug directly from the recorder. Second, the microphone for the audio portion of the video was located, whenever possible, in the center of the verbal "action". This was accomplished by the use of a long extension cord and remote microphone that permitted the observer to move the microphone as needed. Third, the cameras and the recorder are portable. The cameras are designed to be either hand held or tripod mounted. The tripod mount provides additional stability and was used for most situations. Fourth, a cassette tape recorder was used. This type of equipment offers clear advantages over reel machines, particularly in speed of tape replacement. Fifth, the video equipment was always backed up with independent audio tape recorders. These were used initially for note taking. However, it was subsequently determined that when video editing equipment is available, it is much simpler and more convenient to make notes on the audio track of the video tape. Sixth, many foreign flag ships are not equipped with AC current that is compatible with American electrical equipment. Thus, it was necessary to operate on DC batteries on these ships.

4. Debriefing

Following the transit the pilot was asked to review the tape recordings of the transits and to record further explanatory comments on the second, unused audio channel available on the recording tape.

For bar pilots whose transit terminated at the pilot boat, all were willing to view the tapes and record further comments. The comments were frequently "contaminated" with the views and opinions of other pilots present on the boat who enjoyed seeing and expressing views on another pilot's transit. These "group" sessions often continued long after the viewing was concluded and contributed greatly to the author's understanding of piloting practices. For bar pilots whose transit terminated shoreside, only half were able to schedule the time to review their transits.

In the case of docking pilots observed while the study team was primarily working with the bar pilots, only two were able to accept the invitation to review the tapes. This seemingly poor showing was largely a function of their extended work schedules on the tugboats, i.e., the normal seven days on and seven days off the boat. With regard to the docking pilots the study worked directly with, all reviewed each of their transits.

In general, the contributions of the debriefings must be considered only marginally helpful. In great part this is due to the fact that most pilots who made the special effort to review the taped transit had provided good explanations of the piloting events originally. Thus there was relatively little that they needed to add.

C. Implementation Problems

During the preliminary study the general procedures used for obtaining permission for the observers to board a vessel with the pilot involved having the pilot contact the ship's master by VHF radio and briefly identify the study, the study team, and make the request for permission for the observers to board the vessel with him. Invariably the master approved the boarding and with a single exception, permission was also granted to collect data. The procedure clearly leaned heavily on the generosity and prestige of the pilots.

As the second study got underway, one of the steamships companies raised some questions with the Sandy Hook Pilots Association about their involvement in the request for boarding procedures. The Association in turn asked the study team to get them out of the "middle" by making formal arrangements with the shipping companies for boarding their respective vessels. Data collection had to be suspended for several months while trying to comply with the request.

A combination of problems, including the large number of companies owning vessels calling on the port and the many shortcomings associated with written communications, particularly when dealing with subjects such as research, piloting, video recording, observers, et al, created an impossible administrative problem and resulted in several companies declining the request before the effort was finally halted.

When the Sandy Hook Pilots were made aware of the seriousness of the problems being encountered, they generously agreed to once again lend their assistance in boarding the vessel. The informal procedure again worked smoothly without a single refusal. The study team, of course, made no further attempts to board vessels belonging to companies that had refused the formal requests for permission to board.

A much more serious problem involved the failure to obtain high quality, think out loud protocols. All pilots had difficulty, or otherwise resisted, thinking out loud. It was felt that in part this was due to the pilots feelings of uncertainty on what they were exposing themselves to, and how the protocols were to be used. It also seemed that in many instances the pilots did not fully understand what was being asked of them. Thus, the investigators concluded that more than one transit with a pilot was probably needed before useful think out loud data could be expected, and that a video "training tape" illustrating the technique should be included as part of the instruction to the pilot.

With respect to multiple transits with bar pilots, it quickly became clear that enough scheduling variables were involved that, within the time frame of the study, multiple transits were as likely to occur by chance as by plan.

In an attempt to circumvent these scheduling problems, the observers turned to one of the towboat companies and arranged to spend several consecutive days on each of three different boats, whose captains were docking pilots. It was hoped that in this way several transits with the same pilot could be made, thereby providing sufficient time for the pilot to become relaxed and totally familiar with the study and the methods. Although the assumptions appear to be generally correct, the unpredictability of the assignment of ship work to a particular tugboat requires that a lot of relatively unproductive time be spent on the boat while it engages in a variety of other types of harbor work. Further, the docking pilots we rode with felt uncomfortable thinking out loud and consequently resisted the technique in favor of careful explanations of the piloting events and providing their interpretations of how they do the job. Although no protocols were obtained, it should be noted that the time spent was nevertheless very productive for the study team.

The next step was to develop a video training tape. Several transits were made in the Chesapeake Bay and in the Norfolk, Va. area in search of the correct combination of good visibility conditions for the video and a pilot who could and would think out loud. The proper combination came together on a transit from Cape Henry to Norfolk. The tape was later edited to provide instructional explanations designed to enhance its worth as an instructional tool.

Armed with the instructional tape the investigators returned to New York. Several days were spent in the Sandy Hook Pilot Office showing the tape to pilots of opportunity, which consisted mostly of pilots checking in after completing a transit. Most reacted in a positive way, suggesting they would be able to respond as wanted. However, the by now familiar scheduling problems continued to frustrate the attempts to match a pilot, who had viewed the tape and had expressed the willingness to cooperate with the think out loud procedure, with appropriate transit conditions and the study schedule.

As time schedules for the data collection drew tighter, the investigators once again opted to try to stay with one pilot long enough to obtain useable think out loud data. A docking pilot was chosen with 35 years of experience in the port and who was a captain of a tug working a schedule of seven days on and seven off of the boat. The study team stayed with the tug for five consecutive days. During this period, there was an unusually small number of ship movements in the port. Only three ship movements were assigned to the pilot. The second and third were night transits and the video equipment could not be used. Thus, from this point of view, the time was less productive than expected. The tug did, however, engage in a large number of big barge movements in all areas of the harbor and the captain and mate provided many insights and useful items of information regarding ship and barge movements in the port. Some think out loud protocols were obtained also, but were judged to be of limited value because they involved barge work outside the main areas of the harbor.

D. Conclusions and Comments on the Study Methods

Even though the problems inherent in obtaining quality think out loud protocols were unmanageable in the Port of New York, the author remains convinced, based on the few protocols that have been obtained, that the technique offers the opportunity to obtain unique and useful data about the information processing behavior of pilots. When thinking out loud, the pilot is most likely to make explicit the "elements" of information that ultimately lead to a discovery and/or contribute to an analysis of a situation leading directly to important maneuvering decisions.

Many of the factors leading to the failure to obtain quality, think out loud protocols in New York have been described as scheduling problems. But simply identifying them as such falls short of providing an understanding of how they might be overcome.

Drawing on all the evidence it appears likely that given twice the amount of data collection time available to the study in New York, few useful think out loud protocols would have been obtained. Basically, the port is so large, with so many pilots, so widely dispersed over the metropolitan area, that little opportunity existed to effectively communicate with them and thereby perhaps gain the confidence needed to obtain their full cooperation in the use of the technique. To illustrate this point, at least in part, it was always a surprise to the author to encounter a pilot that had, after our many visits and transits, still not heard of the study. But this happened with such regularity that it was clear that the general communications among the pilot was something less than one would normally expect.

Still another factor that probably influences pilots to cooperate, or not to, with such a potentially revealing technique, involves the general attitudes about it prevailing among the pilots within the association. In New York the impression was never fully erased that the bar pilots in general remained suspicious of the motives for the study. Many of the pilots we talked with questioned the motives of the Coast Guard in sponsoring the study and many never seemed entirely satisfied with the explanations offered.

One other factor deserves mention. Many pilots are reluctant to verbalize their thoughts when they can be overheard by the ships' crew, particularly the master. It appears that those who are willing to do this are very self assured persons who are certain of their competence.

If all, or even a reasonable portion of these observations are correct, then the technique is likely to be most successfully used in a smaller port, having fewer pilots who live closer together and interact more than is common in large metro areas. Under such circumstances, it is believed that the communications with the pilots would become manageable, allowing the attitudes of the association towards using the technique to be more accurately assessed and negative feelings more easily handled; briefings and even training, if necessary, could be made manageable; and perhaps just as important as any of these, the "hang-ups" of the pilots could be more easily identified and therefore dealt with, e.g., how should a ship's master best be prepared to accept a "thinking out loud" pilot.

A word about the adequacy of the video equipment is needed. Generally the selection of equipment for this study seemed close to ideal for the project. However, the addition of a low light level video camera, such as, for instance, the Dage 650 SIT which is sensitive in the .01 footcandle range, would permit night transits. Not only would this add a significant dimension to future studies, but it would also remove an important scheduling constraint.

III. FINDINGS

A. Some Background Comments on Vessel Design

1. Conning Positions

Any discussion of the information requirements associated with navigating oceangoing vessels in confined waterways must consider the physical characteristics of the ship in general and the navigation bridge in particular. The perfect vessel for navigating confined waterways would provide for unrestricted visibility through 360°, from waterline to horizon. The need for stacks, deck houses, air vents, cargo handling equipment, et al, make compromises to the ideal necessary. The question of what compromises cannot be made without possible impairment of the safe operations of vessels navigating in confined waters has been the subject of a series of studies by a small group of dedicated Panama Canal Pilots.[2] Unlike many of the studies that have been performed dealing with navigation bridge layout and design, these have approached the problem from the point of view of the professional pilot charged directly with the responsibility of safely transiting all manner of vessels in one of the most restricted and congested waterways in the world. Their concern, as well as their conclusions, directly address the information requirements of the conning officer and the sources of this information as it is impacted by the overall vessel design characteristics as well as bridge design and layout considerations. Having been a beneficiary of their studies, privileged to see, hear and discuss with them much of their work, it is recommended that everyone seriously concerned with piloting information requirements study first hand their conclusions and recommendations. This section draws heavily on their work.

[2] "Ship Bridge Design Criteria" International Maritime Pilots Association August 1976.

Although it does not appear to be generally well recognized outside the piloting profession, there are five identifiable conning stations used in transiting vessels in confined waterways: Position #1 is located in the middle of the bridgehouse on the centerline of the vessel. Positions #2 and #3 are just to the left and right of position #1, respectively, with the location for each dependent on obtaining an unobstructed forward view. Positions #4 and #5 are located at the extreme ends of the port and starboard bridge wings, respectively.

While conning in narrow channels, an unobstructed view from position #1 provides the pilot the best visual information possible for judging his exact heading, his position in the channel and his position relative to other vessels, the aids to navigation, and so on. In the words of the Panama Canal Pilots, "if there is a connection between the soul of the ship and the soles of a pilot's feet, it is located at conning position #1." On many ships the helm is located directly behind this position. To avoid blocking the forward view of the helmsman, pilots try to use the position sparingly. Unfortunately, on many ships the position cannot be used at all. This situation usually exists on ships that either locate cargo handling booms or masts on the centerline of the ship, or group bridge instrumentation, including the helm, in consoles that are placed in front of the windows.[3] Although these are certainly not the only "design errors", from the viewpoint of the safe navigation of a ship, they are among the most common and therefore deserve understanding by anyone involved in ship design and layout problems. The indiscriminate placing of cargo, cargo handling equipments and anything else that obstructs the forward view of the navigating officer is a serious breach of good ship design and is easily recognizable, as

[3]See Figures 1, 2, 3, 4. Photographs courtesy of Captain W. H. Vantine, Panama Canal Pilot.

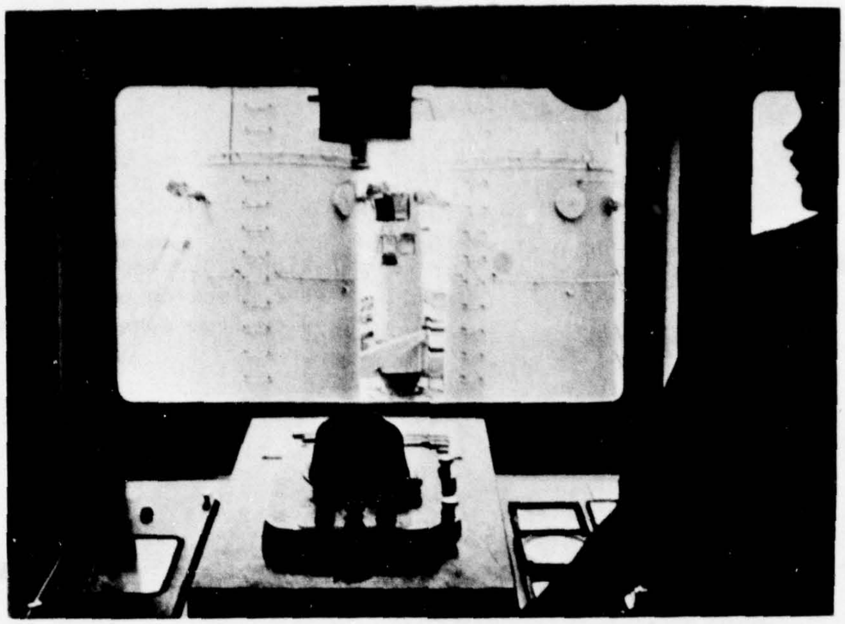
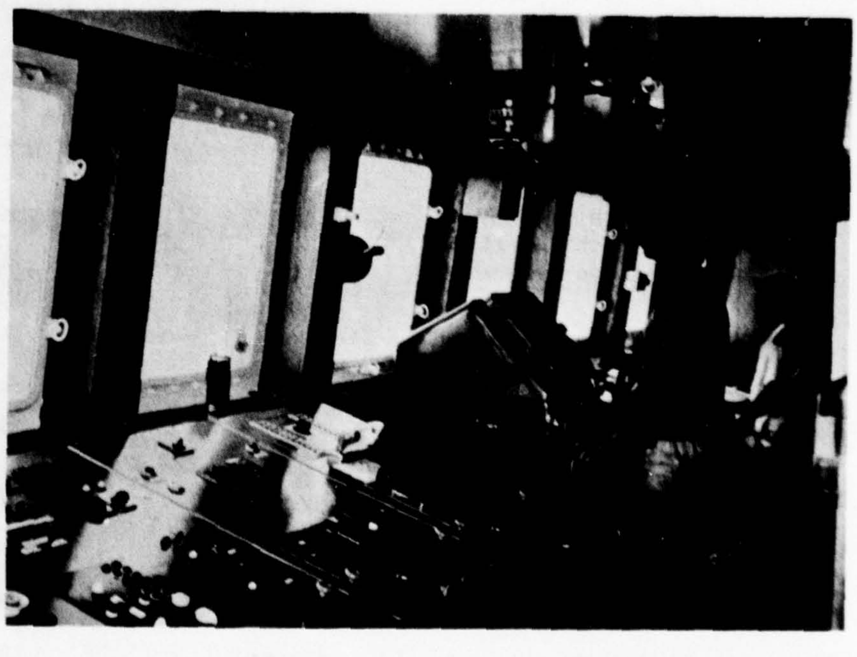


Figure 1 illustrates the view a pilot has from conning position #1 on this ship. The location of the cargo handling gear makes the position unuseable.

Figure 2 illustrates the blocking of conning position #1 by locating the helm forward against the bridge windows. Note also that the placement of the other consoles against the windows prevents the pilot from approaching the windows.



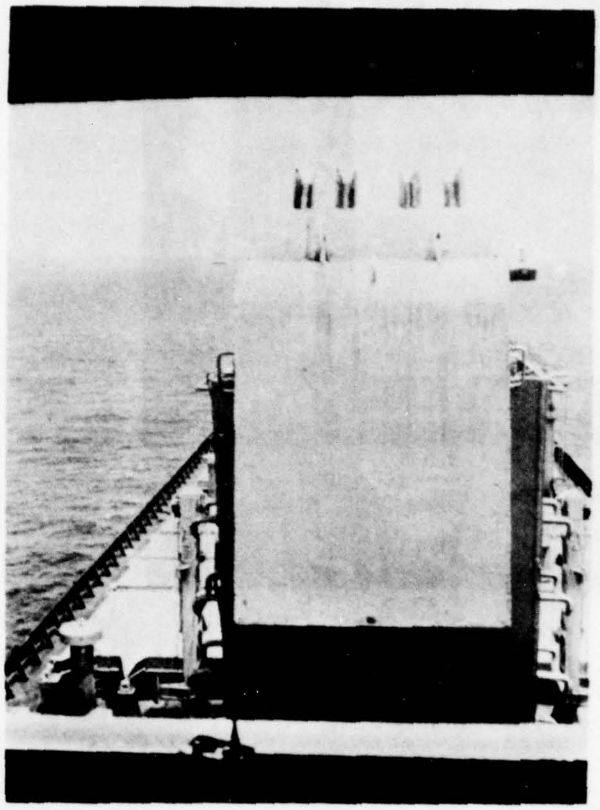
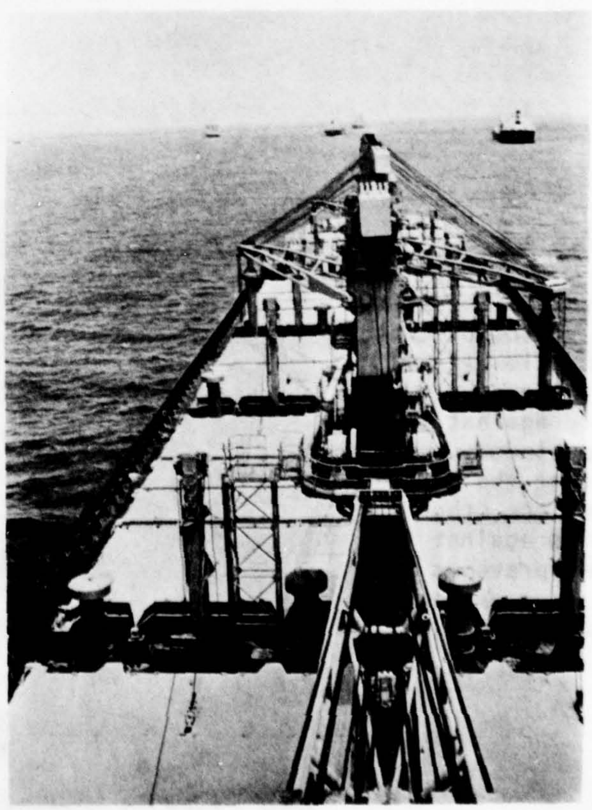


Figure 3. Another example of the blocking of the pilot's view from conning position #1.

Figure 4. The pilots' view from the flying bridge of the same ship pictured in Figure 3 above. This photograph dramatically illustrates the navigational advantage that can be often achieved by raising the height of the navigation bridge by one deck.



such, by anyone who has walked the bridge of such a ship. On the other hand, the problems presented by rows of consoles placed in front of the bridge windows may not be so obvious. The problems arise primarily during inclement weather when visibility becomes restricted by rain, snow and fog and at night when instrumentation lighting reflects in the windows. In all these conditions the pilot feels most comfortable when he can "press the nose" against the glass, if he feels he needs to, to obtain the best possible view forward.[4] The presence of a line of ultra modern consoles, often running nearly the full length of the wheelhouse and positioned flush with the forward bulkhead under the windows, can frustrate attempts to obtain essential piloting information.

For one or more of the reasons noted, the pilot is most likely to work from conning position #2 or #3 while transiting channels.[5] Position #2, to the left of #1, is usually favored in narrow channels, because it provides the better view of oncoming traffic that will be passing in the normal, port side to port side, manner. Position #3 is most likely to be favored in situations where traffic, having the right of way over the vessel, is likely to be crossing right to left and in relatively wide channels under low visibility conditions when the pilot wishes to insure seeing the aids to navigation being passed on the starboard side. The exact location of conning positions #2 and #3 will vary from ship to ship. The pilot will usually select those positions to the immediate left and right of position #1 that provide the best view forward. In the event of obstructions they will move farther to the left, or to the right, to a position just outboard of the edge of the offending obstruction. Obviously, the farther a pilot must move away from conning position #1 the more distorted his perspective of heading information becomes and the more important it is to provide "steering ranges" on the ship.

[4] See Figure 5 - Photograph courtesy of Captain W. H. Vantine
[5] See Figures 6, 7 - Photographs courtesy of Captain W. H. Vantine

Figure 5. Providing a walking space between the bridge console and the windows allows the pilot to obtain the best view possible during inclement weather and minimizes reflections in the windows during darkness.

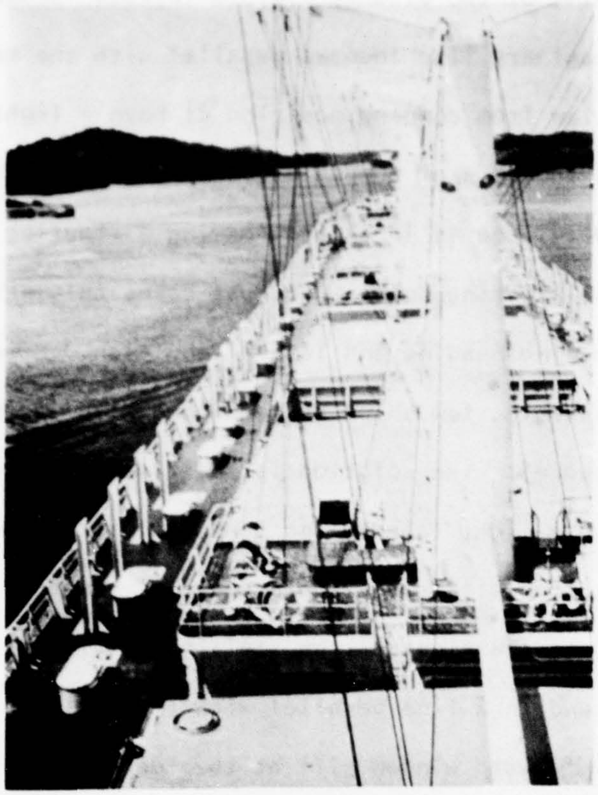


Figure 6. View from conning position #2.

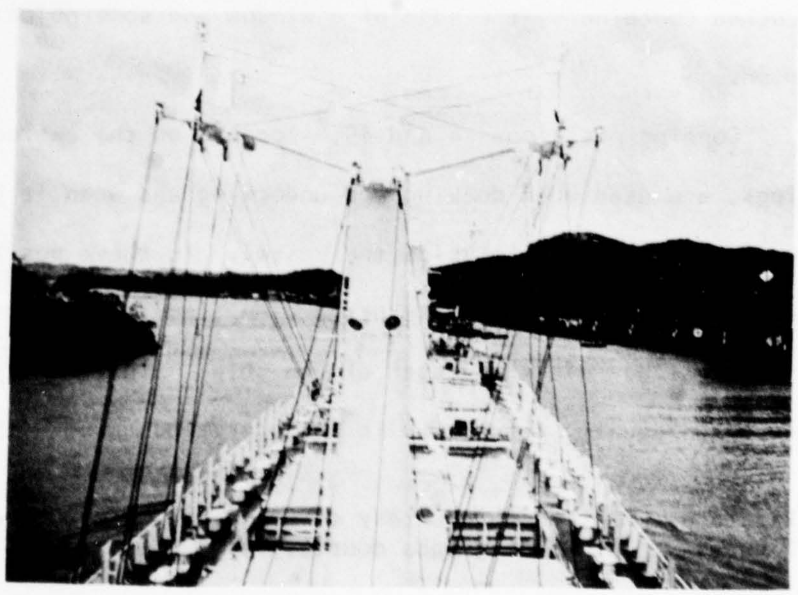


Figure 7. View from conning position #3.

A steering range should consist of two clearly visible objects located, either over the keel, or on an imaginary line located parallel with the keel. Most ships with an unobstructed view from conning position #1 have a light on a jackstaff, or steering pole, on the bows of the ship over the keel.[6] When a pilot stands directly over the keel, he is in effect forming a steering range through his line of sight with the steering pole. For most cases this arrangement serves adequately for determining heading and lateral position. However, should conning position #1 be unuseable, few ships are equipped with steering ranges for conning positions #2 and #3. The solution is relatively simple and inexpensive. A steering pole with a light (the Panama Canal Pilots recommend a blue light to make it different from all other lights ahead of the ship at night) can be rigged to the left and the right of the keel in a position visible from conning positions #2 and #3 and in a line parallel with the keel and a small plaque mounted on or near a forward window sill at the conning position. In the absence of formalized steering ranges pilots must improvise. Since any two objects located over, or parallel with the keel can serve, pilots are frequently observed using the edges of hatch covers, the seams formed by rows of stacked containers, the edge of a window and some object on the main deck, and so on.

Conning positions #4 and #5,[7] located on the extreme ends of the bridge wings, are used when docking and undocking and when it becomes important to observe activities alongside the vessel. In these positions the essential requirement is for an unobstructed view from the horizon through to the waterline, fore and aft the length of the ship. Since both the pilot and the master are often equally interested in the operations around the dock, the embarkation

[6] Figure 8. Photograph courtesy of Captain W. H. Vantine.
[7] Figures 9, 10. Photographs courtesy of Captain W. H. Vantine.

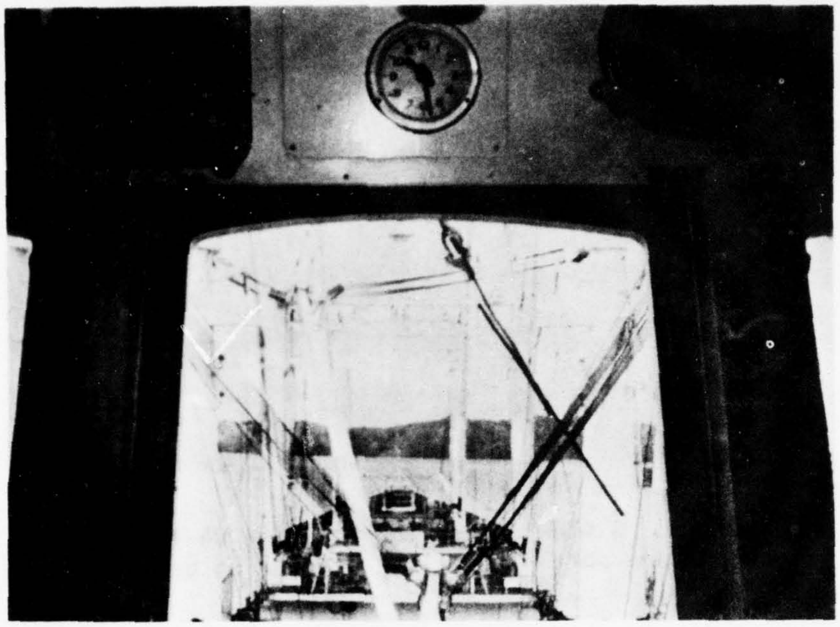


Figure 8. On this Lucia class freighter the cargo handling equipments are located or can be stowed in a manner to permit an unobstructed view of the bows and forward of the ship from conning position #1. The lighted jackstaff located at the bows and the pilot's eye at the centerline of the ship from a range to permit accurate assessment of the ship's heading.

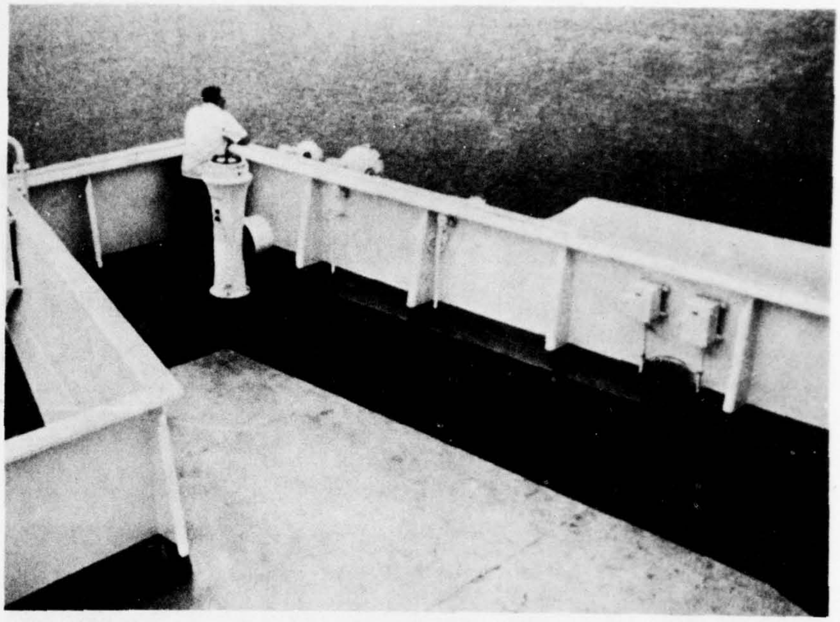
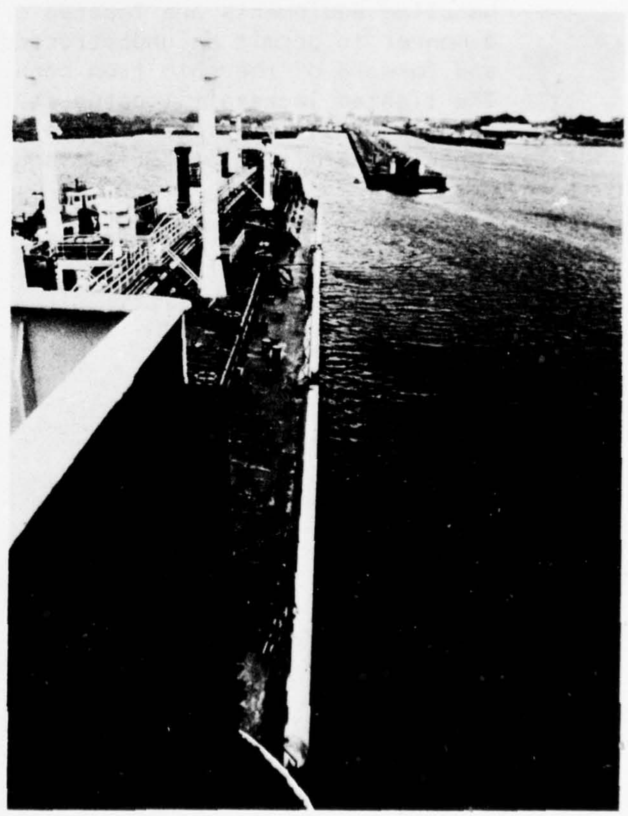


Figure 9. A view of conning position #4 located on the extreme port wing of the navigation bridge.

Figure 10. A view from conning position #5 located on the extreme starboard wing of the navigation bridge.



and disembarkation of personnel, and monitoring other activities close in to the ship, these stations should be large enough for two people to function comfortably at the same time.

From the above discussion, it should be clear that the conning positions on a particular ship evolve naturally from the design characteristics of the vessel. Should the deck forward of the wheelhouse be so cluttered with masts, booms, cargo, and whatever, that an unobstructed view forward is impossible anywhere in the house, then conning positions #2 and #3 will, of necessity, be located on the bridge wing as far out as is needed to obtain that important unobstructed view. Since piloting is primarily a visual sailing activity at this stage of marine transport development, it is mandatory that pilots have the capability to visually acquire and continuously update heading and position information. This is not, of course, meant to imply that any conning position offering an unobstructed view will do. To the contrary, as noted above, the farther away the pilot must move from position #1, the centerline of the ship, the more distorted his perspective becomes. Shipowners and designers who choose to ignore this fundamental information requirement for operation in pilotage waters must surely be adding to the inherent risks of navigation.

This discussion is not meant to imply, either, that pilots never move about the bridge, or never conn a vessel from a position other than those specified. Many individual differences among pilots exist. However, as maneuvering situations become increasingly critical and/or the requirement for exacting judgements regarding heading and lateral position increase, pilots do locate themselves at the position that affords the best visual information regarding the objects of concern and remain there until the situation is relieved. One of the reasons being that in such situations they are frequently using ranges, both on and off the ship, to assess the ship's movements and position relative to the objects of concern and using this information for their maneuvering decisions. Under such circumstances unnecessary movement about the bridge can destroy their references and seriously complicate the decision process.

The ability to identify pilot conning positions, based on the bridge visibility characteristics of a vessel, can serve as a useful aid for solving many difficult bridge design and instrumentation layout problems. Such identifiable positions can serve as a focus for locating bridge instrumentation providing important maneuvering information and control functions. To illustrate, conning position #1 is a key work area for the pilot while transiting areas where precise navigation judgments are critical. If the pilot is required to move physically from this position to view the rudder angle indicator, to insure that the helmsman is correctly following his last order, he can quickly lose his references. Likewise, he should be able to easily see the gyro compass, the engine order telegraph, the propeller revolution tachometer, the fathometer and the rate of turn indicator if the vessel is so equipped; furthermore, he needs access to the VHF radio, the ship's whistle and perhaps the bowthruster.

Generally, the same instrumentation should be readily accessible at all three conning positions located inside the wheelhouse. During docking and undocking maneuvers when the pilot is at positions #4 and #5, the order of importance of the information and control instrumentation may change, but the principle remains very much the same: The pilot should not be required to physically leave the conning position to acquire important navigation information, to give orders and monitor their execution and to carry out directly certain critical actions, such as using the ship's whistle and the bow and stern thrusters if the vessel is equipped with them.

2. The Engine Order System

The reader who views the video tape recordings presented as a part of this study and listens carefully to the engine orders given by the pilots may well be puzzled by the seemingly archaic methods of propulsion control being used on modern ships. Statements by pilots, such as, "dead slow ahead is too slow and slow ahead is too fast" may be nearly incomprehensible to people who are used to the rather precise and direct control exercised over the propulsion power of other transportation systems. Thus, it is the purpose of this section of the report to provide the reader some general understanding of the characteristic methods of controlling the main propulsion plant and the attendant problems faced by the pilot when maneuvering in confined waters.

Normally, the responsibility for all engine room operations and the direct control of the plant while maneuvering, is in the domain of the ship's engineers. They operate the plant in accordance with engine orders issued from the navigation bridge by the conning officer through the watch officer. Such engine orders are usually communicated via an engine order telegraph (EOT).[8] In the event the order exceeds the capability of the EOT, a voice communication system is available.

The EOT may vary from ship to ship with respect to the number of different orders that can be issued via the instrument, the location of the order positions on the visual indicator, it's location on the bridge and even in it's overall design characteristics. On some "modern" ships the EOT has been incorporated into consoles and others have substituted pushbuttons and elaborate overhead visual status indicators for the traditional EOT pod.[9] From the pilot's point of view, the failure to provide immediate visual access to the EOT from all five conning positions and the lack of standardization of the instrumentation are of primary concern.

[8] See Figure 11. Photograph courtesy of Captain W. H. Vantine.
[9] See Figures 12, 13. Photographs courtest of Captain W. H. Vantine.

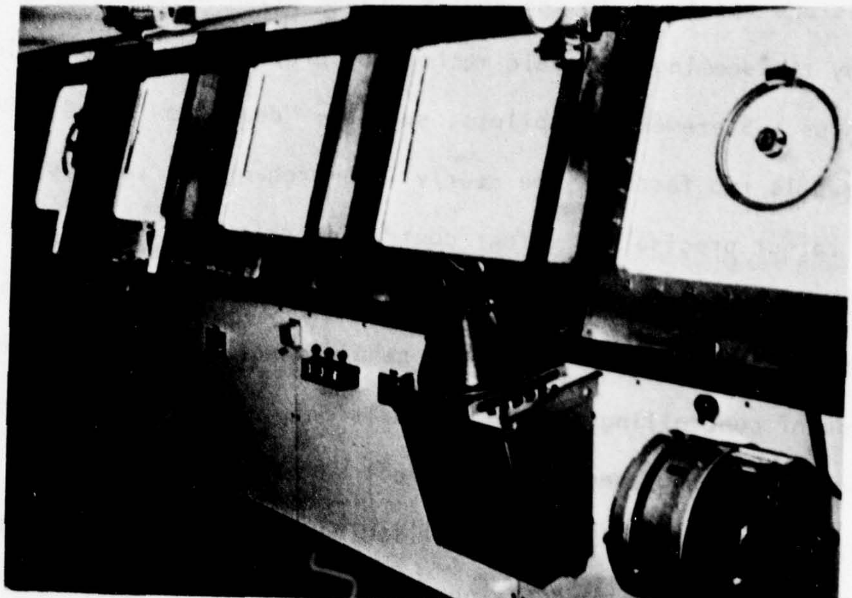


Figure 11. An engine order telegraph of reasonably conventional design can be seen in the lower right hand corner of this photograph. It is mounted to the deck.

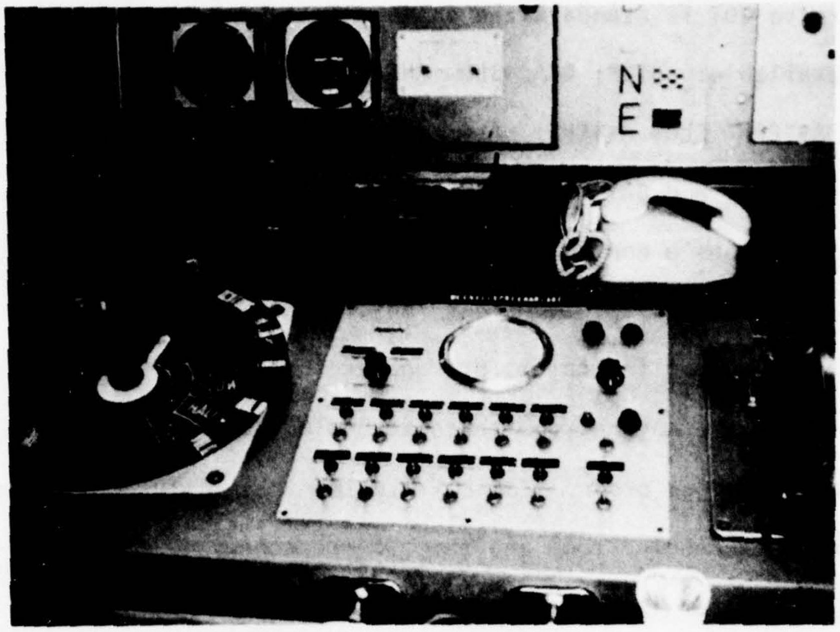


Figure 12. An example of an engine order telegraph incorporated into a console. A basic problem with this design is that it cannot be seen by the pilot from his usual conning positions.

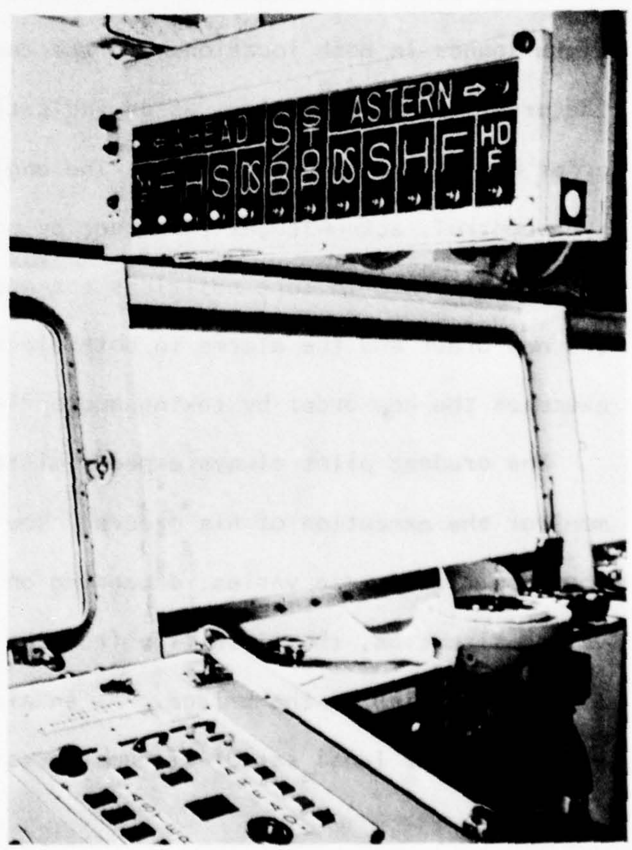


Figure 13. This "ultra modern" engine order telegraph features a pushbutton control/display panel incorporated into a console (in the left hand corner of the photo) with a large lighted display suspended from the overhead.

To the extent that the EOT is standardized on merchant ships the following orders are generally available: STOP: DEAD SLOW AHEAD: SLOW AHEAD: HALF AHEAD: FULL AHEAD: DEAD SLOW ASTERN: SLOW ASTERN: HALF ASTERN: FULL ASTERN: STANDBY ENGINE: FINISHED WITH ENGINE: and BRIDGE CONTROL, on vessels so equipped.

The EOT pod type design has a control handle for positioning the "order indicator". When the handle is moved, the order indicator is also moved to indicate the new order. A second indicator, or "answer indicator", remains on the previous order until the engine room takes acknowledgment action and it then moves to the acknowledged order. The EOT display is exactly duplicated on the control console in the engine room and the two are connected electrically. When the conning officer issues a new engine order, the watch mate moves the handle and the accompanying order pointer to the ordered position. The order pointer in the engine room moves to the new order and an audible alarm sounds in both locations; in the engine room to alert the engineer to the order and on the bridge as an indication to the conning officer that an order was given the engine room. The engineer, usually by means of a knob type control, acknowledges the order by positioning his answer pointer on the new order. This in turn positions the answer pointer at the bridge EOT on the new order and the alarms in both places are silenced. The engineer then executes the new order by taking appropriate throttle actions.

The prudent pilot always expects mistakes and takes reasonable care to monitor the execution of his orders. How does he monitor this procedure? The answer of course varies, depending on many factors, including the maneuvering situation, the visibility from the bridge, and the instrumentation and its' positioning on the bridge. As an aid to understanding, let us first assume a more or less ideal set of circumstances: The ship is proceeding in the engine maneuvering mode in a straight channel 1000 yards wide, visibility from the bridge is unlimited, the pilot is in conn position #2 and the EOT and the engine tachometer are both easily visible from this position, the ship is steaming full ahead at 10 knots and the pilot decides to reduce speed to 8 knots for a traffic crossing area ahead.

The pilot orders <u>half ahead on the engine</u>. The mate repeats the command and immediately moves the EOT order pointer from full to half. The mate then manually records the order and the time it is given in the EOT Log Book. The pilot may have looked at the mate who was hopefully positioned by the EOT, as he gave the order and directly observed the action taken. Otherwise, he at least hears the alarm.

The alarm sounds in the engine room and the order pointer moves to half ahead. The engineer so alerted moves the answer pointer to half ahead and the alarm is silenced, both in the engine room and on the bridge. He then proceeds to move the throttle to the engine RPM position designated for half speed in the maneuvering mode. (Here it should be noted that most ships, although not all, post the relationship between order, engine RPM and ship's speed, for both the maneuvering mode and normal mode of engine operation, on the bridge and in the engine room. Thus, the pilot has probably selected an order that gives an engine RPM that most closely approximates the speed through the water and/or over the ground that he has from previous learning and experience determined most satisfactory under the circumstances.)

As the alarm on the bridge is silenced, the pilot is now reasonably confident that the engine room is taking the actions necessary to respond to his order. Knowing the type of main propulsion plant (motor, steam, et al) the ship is equipped with, the pilot can reasonably estimate the time interval between engine room acknowledgment of the order and when the engine response can be expected to be discernable on the tachometer and on the ship's behavior. Ships of the same class can and do vary in their response time and pilots adjust their anticipation time to correspond with ship and crew responses by observing the time interval required for the response from several orders. These adjusted response time estimates become very important as the maneuvering situations become more critical, in that pilots try to incorporate the response time into their orders. That is, pilots will give an order earlier on ships with "long" response times as compared with ships having shorter response times.

The pilot continues monitoring the execution of the order by observing both the tachometer and the responses of the ship. The tachometer begins to reflect the drop in RPM's as the engineer throttles back, and changes may be noted in the vibration characteristics of the ship, the noise level, the bow wave, the wake, the headway as observed by looking at stationary objects abeam of the ship, a change in the rate of approach to an aid to navigation, or all of these. The pilot's monitoring of this particular order might be considered to be complete when the tachometer indicates the appropriate RPM for the order.

As can be readily seen from the above illustration, under the best of conditions, the procedure in common use for controlling and monitoring the propulsion forces on ships involves a chain of actions and reactions that seems much more appropriate for controlling the spill gates on a dam than controlling the movement of a modern transport vehicle. With a little imagination, or perhaps referring to the video tapes, one can understand the complications that can occur if the pilot does not have ready access to the mate, the EOT, the tachometer, or all of these. Suppose for example, it is nighttime, the channel is narrow, a port side to port side passing is developing with another large ship, the pilot is at conning position #4 with a visual range astern of the vessel, there are no repeater instruments, i.e., EOT and tachometer, on the bridge wing and the EOT audible signal is not working. How does the pilot insure that his order is being properly executed?

To this point the emphasis has been on the potential problems in system reliability resulting from the relatively long chain of actions and reactions involving the pilot, mate, engineer and back to the pilot in issuing, executing and monitoring the engine order. Still another problem exists in the system that bears some discussion. That is, the "lumping" of the full range of engine RPM ahead or astern into five order categories respectively: STOP, DEAD SLOW, SLOW, HALF and FULL. It is this characteristic of the system, of course, that leads to the "dead slow is too slow and slow is too fast" type of comment noted earlier. In many piloting circumstances, it would obviously be desirable to be able to control the thrust of the engine more precisely. As another example of this, the reader may wish to view the video tape recordings covering the docking portion of the transit of the Greek ship, Stawanda. The Stawanda was being docked on the fair tide.[10] When the ship is maneuvered into the desired fore and aft position relative to the dock, the pilot needs to hold the vessel "dead over the bottom of the channel" with respect to this fore and aft axis of movement while the tugs push the ship sideways to the dock. To do this maneuver on a fair tide he must constantly alternate between dead slow astern and stop engine orders. In this case dead slow astern was a few revolutions too strong, particularly as the tugs moved most of the ship out of the stronger currents. Had the pilot had access to the throttle, as the engineer does, he could probably have adjusted the turns astern to the strength of the current and eliminated the necessity for many of the engine orders and thereby further reduced the likelihood of system errors.

[10]A fair tide is a tidal current that increases the forward speed of the vessel.

In relatively recent years significant advances have been made in automating the engine room. Increasingly, new ship constructions are being equipped with the capability for operating the propulsion plant from the navigation bridge. On these ships direct control of the engine(s) can be located, either in the engine room or on the bridge. The pod type EOT is replaced with a console providing a throttle(s) calibrated in engine(s) RPM's; tachometer(s); displays showing throttle valve positions, ahead or astern; switches to transfer control between engine room and bridge; a communications capability between engine room and bridge; an EOT display and control to permit standard orders to be sent to the engine room; and a variety of "idiot" lights and alarms.

Based on very limited observations (four ships), it appears that Foreign Flag vessels equipped with a "bridge control" capability usually operate in that mode in restricted waters. However, in no instance did we observe a pilot issue other than a standard order. U. S. Flag vessels so equipped never make use of the bridge control capability due to jurisdictional problems between unions representing deck and engineering personnel.

When questioned about the control problems associated with "lumping" the full range of engine responses into five order categories, pilots generally seem to agree that the procedure often makes the job more difficult. However, they are usually quick to caution that issuing orders such as, thirty-seven RPM's or 26 turns, complicates the communications problems, particularly on ships where the native language of the crew is not English. They continue by observing that the standard orders are universal the world over and this fact alone makes it difficult to consider changing the system. Still another argument is offered along different lines. This one points out that in many piloting situations precise control of the engine RPM's is not critical. What is critical, the argument maintains, is that an approximately known amount of thrust is provided for ahead and astern movements, or additonal rudder power, and the five standard orders handle these situations adequately.

Based on the limited observations from this study, it is concluded that the arguments on both sides of the question have merit. Certainly, the existing engine order system and procedures used on most large ships fail to provide the opportunity for exercising the precision of control that is desirable in many situations, particularly, in view of the increasing ship sizes operating in our relatively "shrinking" waterways. Certainly also, the existing system on most ships, including those with bridge control, can be significantly improved by standardizing and locating the instrumentation within easy viewing of all five conning positions. On ships with long bridges the need also exists for repeater instruments, or a communications link between conning positions #4 and #5 and the EOT, or whatever type of control station exists.[11] Weather and machinery noises often make communications difficult. Finally, experience generally indicates that the greater the number of actions and reactions required from people and equipment to execute and monitor an order, the more vulnerable the system is to error.

The pilot's arguments, in the context of existing systems and practices certainly have face validity. It is very doubtful that there is a practicing pilot anywhere that has not been, on numerous occasions, in serious difficulty because of communication errors. Their concern is quite understandable. But, the argument appears to have two edges. It argues as eloquently for the need to eliminate all necessity for verbal communication as it argues for not changing the system. The second major argument, that many piloting situations do not require

[11]See Figure 14. Photograph courtesy of Captain W. H. Vantine.

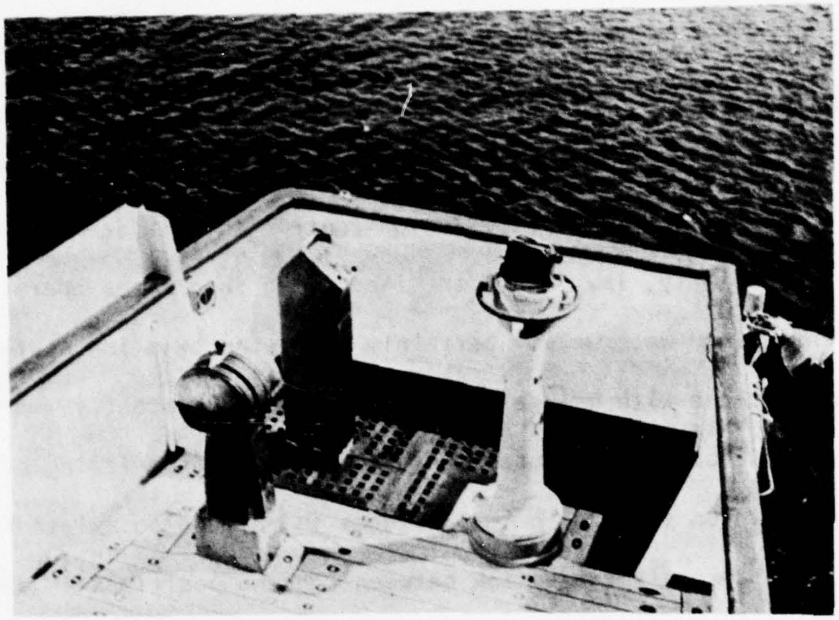


Figure 14. On this vessel both conning positions #4 and #5 are equipped with an engine order telegraph (left), bowthruster, (center) and gyro (right) repeaters.

precise control of the engine, is true. But then a system permitting precision of control when needed does not necessarily exclude the alternative of "lumping" engine RPM's when this is desirable.

The development of bridge control systems is obviously in the right direction. However, one easily gets the impression that navigation considerations play a poor second role to the economics associated with reduced manning requirements in the engine room. The technical problems involved now need careful study from the point of view of improved safety in the navigation of the ship.

B. Basic Information Sources

1. Local Knowledge

To review the planning procedures recommended for preparing a vessel to navigate pilotage waters, as presented in one of the most authoritative marine navigation handbooks[12], is to develop some appreciation for the extent and diversity of the local knowledge professional pilots bring to their jobs. The following quotation provides a summary of these recommendations:

"Preparations for entering are similar to those for getting underway. The tide and tidal current tables, light list, coast pilot or sailing directions, and charts should all be broken out and studied so that one is familiar with conditions to be encountered. The time of entering might be selected to take advantage of favorable currents, and to arrive at the assigned berth at slack water. One should have a mental picture of what to expect when approaching from seaward under the anticipated conditions of lighting and visibility. The characteristics of all aids to navigation by day or night, as appropriate, and fog signals should be known or immediately available. In entering a strange port the navigator should carefully select the most suitable aids to use, with substitutes if these prove inadequate, or if there is any doubt as to their identity. Useful ranges, natural or artificial, should be noted. Danger bearings and danger circles should be drawn in and labeled, if this has not already been done. A danger sounding should be selected and drawn on the chart, if needed. Any shoal areas, wrecks, areas of unusually swift current, etc., should be noted.

The courses to be steered and the distance on each should be determined and recorded, or drawn and labeled on the chart. The identification of each turning point should be indicated. Definite courses should be steered, and changes made only when established positions indicate a departure from the planned track, or when necessitated by traffic. Course changes should occur at preselected points having definite identification. The position should not be permitted to be in doubt at any time, even in ports which are familiar to the navigator and considered easy to enter. Most avoidable groundings are caused by erroneous assumptions which should have been verified. The position should be checked frequently, using the most reliable information available."

Bowditch, of course, was writing for the ship's navigator and not the professional pilot with hundreds or thousands of transits and many years of

[12] Bowditch, Nathaniel <u>American Practical Navigator</u>; U.S. Navy Hydrographic Office, Pub. #9, 1962, pp 601-603 (This quotation also appears in essentially the same form in the 1977 edition.)

experience in the port. For the most part his advice and recommendations to the navigator are along the lines of developing sufficient advanced local knowledge that, when combined with valid and systematic measuring, fixing and plotting procedures, the pilotage transit can be safely and efficiently made.

Looked at another way, the Bowditch quotation with some changes could qualify as an operational definition of local knowledge. In the absence of an authoritative definition of local knowledge,[13] it may be useful to look in more detail at his summary of planning elements.

Bowditch first suggests that all publications "be broken out and studied so that one is familiar with conditions to be encountered." The publications, of course, represent a primary, or perhaps more accurately a secondary, source of local knowledge. Up to date charts of the approach to the harbor entrance and the harbor area must be assembled. Depending on the ultimate destination and the detail needed, several charts may be required for the transit, ranging in scale values from perhaps 1:40,000 to 1:15,000. With the charts in hand and arranged in the order of intended use, the navigator must then proceed to check their currency against such other publications as the weekly "Notice to Mariners" and the annuals, coast pilot and light lists. With information from these sources, he can update the various charts with the changes that have occurred since their publication. Next, noting the estimated time of the transit in inland waters, he may check the tide and tidal current tables for the water depths and current conditions to be expected along the transit route.

[13]Although local knowledge is in common usage among mariners, no formalized definition could be found in any of the standard references.

Once all this information is at hand the navigator is now ready to start planning the pilotage transit and integrating the published information with his ship's handling characteristics, weather conditions, expected visibility and so on. The results of this planning are noted, for the most part, on the appropriate charts as courses to be steered, distances, turning bearings, advance and transfer characteristics of the vessel, certain critical aids to navigation given expected conditions, and so on.

During the transit the navigator directs a bridge team in identifying selected landmarks and other aids to navigation for taking bearings and fixes, and continually plots and compares the ship's position and advance against his advanced planning, making revisions as necessary.

Clearly, for the assumptions made by Bowditch, there is no present substitute for the general procedures and practices outlined. Every authoritative source book on pilotage endorses these practices and their subject matter is devoted almost exclusively to detailing techniques for measuring, fixing and plotting vessel position information.

In contrast to the planning recommended for the ship's navigator who is entering, say the port of New York for the first time, the experienced New York pilot does the job differently and in all likelihood much more accurately. First, consider the publications and how the experienced pilot uses them. With respect to the nautical charts, the pilot long ago memorized them in order to obtain his piloting endorsement. If he pilots the area regularly, he has added in both quality and quantity to these "cognitive charts". His scale and detail are based on the needs of the moment and his updating may be as current as the last VHF radio communication. Furthermore, his cognitive chart for some purposes not only contains the abstractions of the type found on the published charts, e.g., the Ambrose Channel R "10" buoy is quick flashing red and has a gong, but for other purposes can be "seen" and "heard" to the extent that he can visualize the structure, streaked with white owing to the attentions of the gulls, and may even remember the sound of the tone it emitted night before last in that sudden rainstorm. In other words he truly has the "mental picture of what to expect" that Bowditch advocates.

With regard to the "Notice to Mariners" and other publications announcing changes, the conscientious pilot checks them regularly, however, he is more likely to see the changes first hand, or hear about them from his colleagues through the VHF radio communications, notices posted in the pilot office, or boat, or in face to face conversations with working pilots. Indeed, frequently enough these important notices originate with the pilots and they as a group are among the first to know.

Pilots carry copies of the tide and tidal current tables with them aboard ship and use them in much the same way as the ship's navigator would. However, because the pilot can interpret them in the context of his more extensive background of local knowledge, they probably are more meaningful to him. Since the tables only provide predictions of conditions, they are best "read" in the context of prevailing winds, weather, variable river currents and the changing characteristics of the bottom and the vessel. Thus, the professional pilot working the area regularly is more likely to be able to interpret the projected conditions as dynamic forces that will be acting on the vessel along different areas of the transit route. It is also likely that the pilot can more quickly detect differences between predicted and actual conditions.

Thus, it is that the mechanics of planning, as carried out by the ship's navigator, little resembles the planning performed by the professional pilot, even though both may engage in planning for the transit and both may arrive at the same end result, a safe and efficient transit. The differences appear to be based almost totally on the quality and quantity of local knowledge possessed by the person directing the movement of the ship. The navigator unfamiliar with the port must acquire a semblance of local knowledge through the systematic study of a variety of publications; detailed and dynamic, local knowledge is the professional pilot's stock in trade.

Likewise, the navigation procedures required during the transit will vary directly with the local knowledge of the person directing the ship's movement. Assuming a person with little, or no local knowledge is conning the vessel, the navigation team will be engaged continuously in identifying aids to navigation and landmarks, verifying ship's position by taking bearings and fixes, and plotting them on the charts. On the other hand, an experienced pilot with his extensive store of local knowledge will rarely find such procedures necessary, or even useful.

Perhaps it should be clearly stated at this point that this discussion is not intended in any way to challenge the validity or the need for careful planning for a ship transit in restricted waters, or to otherwise question the time proven navigation procedures for accurately measuring, fixing and plotting the ship's position during the transit. Just as good shiphandlers do not depend on any single source of information to fix the ship's position, if any other sources are available, it is equally true that no single person ought to be totally relied upon to insure the safe navigation of a vessel. Redundancy in all navigational procedures seems desirable. Rather, the point is a much simpler one. Namely, that to a very large extent the information needed to safely navigate a vessel in pilotage waters can be classified under the heading of local knowledge, and in one way or another, the person directing the movement of the vessel must have or acquire at least a semblance of relevant local knowledge. In this case more is definitely better. If the conning officer has little direct local knowledge, he must increasingly rely on relatively involved and time consuming navigational procedures that at best provide incomplete information and are susceptible to errors from a variety of sources.

It is always a little unnerving to attempt to pin down in a brief statement, or definition, anything as broad ranging as is implied in our usage of the term local knowledge. There are, however, certain characteristics of local knowledge that tend to set the term and it's general usage apart from other types of navigation information and their sources used in pilotage. It is in this spirit that the following definition is intended: Local knowledge includes all the types of navigation information about a pilotage waters area that exists in the various marine navigation publications and among the professional mariners holding pilot endorsements who are actively directing ship movements in the area. The information exists, with some exceptions, e.g., tide and tidal current tables, in the long term memory of the holder and can be recalled upon demand, or by situational factors.

2. Transit Specific Information

As noted above, source books covering the subject of pilotage typically ignore the job as it is performed by professional pilots working in a port. Rather they tend to concentrate on the variety of measuring and chart plotting techniques available for fixing the vessel's position, estimating speed and distances, establishing danger bearings, et al, that is much more akin to the techniques a non-pilot navigator might use in entering and leaving a port. Occasionally, such as in Bowditch, recommendations for planning are included as an introduction to the subject matter. For the most part, these planning recommendations take the form of encouraging the navigator to obtain, in advance, sufficient local knowledge to be able to reliably use the traditional position fixing and plotting techniques. Quite understandably the dynamics of the transit situation cannot be treated to any significant degree. Part of the difficulty rests with the fact that pilotage involves a continuous series of actions and reactions, and as such, the problems encountered do not yield readily to pre-planned solutions. As pilots are quick to point out, no two transits are ever the same. The transit situation is much too dynamic to expect that the most carefully planned scenario will be duplicated in the actual transit.

Since the pilot's stock in trade is his local knowledge, it is clear that for his regular transit routes little or no planning for the purpose of acquiring more local knowledge is necessary. Further, he will only in rare instances directly profit from the application of the traditional navigational fixing and plotting disciplines. So, it might be asked, does the pilot do pre-transit planning, and if so, what are it's characteristics?

Based on observations in New York and elsewhere, it is concluded that pilots do engage in planning, albeit informal, largely private, and very much situationally oriented. The planning can be characterized as the working out of certain complex interactions among the three basic information sources that the pilot, either brings to the situation, or develops as the transit progresses: His local knowledge, his knowledge of shiphandling techniques, and the transit specific information he develops before and during the actual transit. Local knowledge and shiphandling knowledge are probably relatively constant for a given pilot across transit situations. Transit specific information on the other hand is unique to each transit and as it is obtained and integrated with the other information sources, permits the pilot to plan for and solve the problems anticipated and encountered in the transit. The type of transit specific information being sought by the pilot generally involves the dynamics of the transit route, ship dynamics, and their anticipated and actual interactions.

The initiation of the "build up" of transit specific information, depending on the pilot's perceptions of the situation and the opportunity for developing useful information, may start hours before the scheduled transit. For example, suppose he is on the pilot boat and a serious storm front is moving through the area. Under these circumstances, he is likely to avail himself of every opportunity to acquire information about actual and forecasted weather conditions along the transit route. He will almost certainly go to the bridge deck of the pilot boat to monitor weather forecasts and the VHF bridge to bridge communications of ships in the area. He likely will review traffic schedules with the watch crew and observe traffic movements on the radar presentation. He will observe wind and sea conditions. The pilot will also likely review all known information about the ship he is scheduled to transit, including it's latest ETA at the pilot boat. Tide and tidal current tables will be consulted and the pilot will likely draw some conclusions regarding the conditions he expects to experience throughout the transit route; he may also have the opportunity to speak with other pilots, who have just completed transits, about the conditions they encountered and expect. In this manner he starts building an information base that in the context of his local knowledge and knowledge of shiphandling, allows him to anticipate something of the dynamics of the transit route that are likely to prevail during his scheduled transit.

As the motor launch approaches his ship, he may be able to visually check the deep draft and trim; observe the wind sail area; the position of the propeller(s) in relation to the surface of the water; the rudder(s) position and size relative to ship size; the hull shape; the flair of the bows; the position of the navigation bridge; the on-deck cargo stowage and the type and location of cargo handling equipments, and other relevant conditions. Upon boarding, the buildup of information continues. He begins to gather impressions of the mate, the master and the helmsman. Do they communicate well in English? If not, what is their native language? What communication problems may exist between them and how best can they be handled? Important bridge instrumentation are noted: Where is the VHF radio; what type is it and how does it work; is it working properly; what channel(s) is being guarded? What engine order is in effect? Does the engine tachometer work and how many RPM's is indicated for the ordered speed? What is the heading now? Is the gyro compass working and is it accurate? Where is the rudder position indicator located, what does it read and does it correspond with the ships's behavior?

All these things and more may be assessed by the pilot, even before he starts the job, and added to his store of information relevant to this particular transit.[14]

As the pilot begins to issue helm and engine orders, the information buildup continues along somewhat different lines. He now has the opportunity to observe directly both the crew's and the ship's responses to his orders and "compare" them against his experience background with many other vessels, and perhaps the same vessel on other occasions. He may observe that the vessel responds readily or slowly to the rudder; that engine response times appear better, average, or slower than other vessels with this type of propulsion system; the helmsman is competent, average, or incompetent; the master is cool and confident, or maybe is a bit edgy; the wind and seaway is having little, average, or great effects on the way the vessel handles, and so on. It is this "order and response" type of information that is probably the most crucial in allowing the pilot to integrate the basic information sources into workable plans. The more orders he gives the more confident, or concerned, he becomes regarding the crew and vessel responses he can expect, the lead times involved and how anticipated transit situations may best be handled.

As the transit proceeds, the buildup of transit specific information continues. The pilot has increasing opportunities to observe the seaway, the

[14]Although the discussion may suggest that the pilot is using a "checklist", most pilots would probably disagree with this representation. It is more likely that for many of the items mentioned, the pilot's attention is captured by the nonstandard, unusual, or unexpected. For example, in approaching the ship it is not likely that most pilots consciously observe the trim and make note that "she is in good trim fore and aft", but rather, are more likely to consciously notice when the ship is significantly out of trim, such as being "down by the head", or stern. Likewise, the pilot may not consciously read the draft unless the ship appears unusually deep or light, or different than the pre-transit report he may have received.

behavior of the vessel, and the subtleties of their interactions. Based on this developing understanding of the interrelationships of the dynamics of the vessel and the seaway, he may, as an example, plan to start the first turn where he usually does with this size vessel, or he may decide that it must be started earlier, or later. One or several considerations may need to be weighed and judged in making the decision: The set and drift being experienced in this leg of the channel and the anticipated set and drift for the next leg of the channel. The rudder response characteristics of the ship and the speed of the ship through the water. Traffic conditions before, during, and on the other side of the turn. The extent to which the wind and the current will be working with, or against the vessel. The expected order response time of the crew and the ship. Visibility conditions. And perhaps many other, or different factors, depending on the circumstances.

Of course, all the examples are hypothetical. Hopefully, they serve to illustrate the general types and the characteristics of an important source of information the pilot actively seeks out, both before and during a transit. Such transit specific information probably serves, most importantly, to provide the pilot with his "feel" for the dynamics of the transit situation.

3. Shiphandling Knowledge

Of the three basic information sources identified as being critical to the safe and efficient transit in pilotage waters, the concept of shiphandling knowledge is the most illusive and difficult to treat. There are several reasons: First, all three information sources--local knowledge, transit specific information and shiphandling knowledge--interact in complex ways to influence the order decisions. Order decisions probably need to be analyzed on a "case by case" basis, in the total context of the transit, to sort out the information sources that contributed to a particular decision. Second, specific shiphandling techniques appear to become identified with particular transit areas and/or situations and become a part of the local knowledge of the pilot. Third, the shiphandling "label" is so broadly applied in common usage that in one context or another it covers almost every aspect of ship movement. Fourth, errors from any of the interacting information sources can lead to errors in the order decision. However, because the ultimate movement of the ship is usually the most easily observable response to the pilot's information processing and decision behavior, observed errors, regardless of source, are usually classified as shiphandling errors.

No completely satisfying solutions, either in the form of a precise definition of shiphandling knowledge as it applies to confined waters, or otherwise, seem to exist at present for dealing with the interactions between the basic information sources and/or establishing relative importance in many maneuvering situations. Our own tendency, or bias, is to view shiphandling knowledge as a background information source for all order decisions and to generally relegate it to a level of lesser importance in the decision process than either local knowledge or transit specific information. Our reasoning is based on several assumptions: First, shiphandling knowledge is clearly a prerequisite to controlling ship movements. Second, professional pilots have ample opportunity for exercising their shiphandling knowledge on a regular basis on many different vessels. For the kinds of situations they typically encounter, the opportunity for overlearning certainly exists. Finally, shiphandling as a control fuction is relatively easy to learn. The difficulties seem to lie with accurately "reading" the dynamics of the situation, e.g., predicting and/or detecting the presence or absence of physical forces acting on the ship that require control actions.

Based on the careful viewing of the video recordings, it would appear that some pilots have a better "feel" for shiphandling than others, i.e., they seem more confident while performing, their orders are logically and consistently related to the situation at hand, and their timing is often flawless. On the basis of such observations, it is tempting to conclude that the greatest individual differences among pilots are in their shiphandling knowledge. And in point of fact, this conclusion has been taken in a number of instances. In some cases it has led to expensive simulator training programs, designed presumably to improve shiphandling knowledge. At other times, it has led to the "washing out" of apprentice pilots, and even occasionally to volunteer termination actions by First Class pilots. Because of the seriousness of such actions, it would seem that the conclusion should be approached with some caution. At least from our viewpoint, observed performance differences between pilots might just as easily be attributed to differences in their accuracy and depth of local knowledge and the manner in which they accumulate and use transit specific information, i.e., differences in the precision and accuracy with which they "read" the dynamics of the transit situation. Certainly, we do not know at this point which, if either, conclusion is correct, but it does appear to be an experimentally testable proposition having important implications for accident research and the design of training programs.

C. Major Transit Routes

1. Ambrose Channel

Ambrose Channel is the primary ship channel to the upper bay of New York Harbor.[15] It is named for the man who did the original survey work that established it's location. According to a "historian" among the Sandy Hook Pilots, Mr. Ambrose worked carefully and accurately to identify the original river bed that carried the Hudson River flow to sea. Because of his efforts, siltation, a problem for shipping in other areas of the harbor, presents minimum problems in Ambrose Channel.

The channel is dredged to approximately 42 feet at mean low water, is 9.2 nautical miles long, 2000 feet wide and is marked on the eastern or seaward end with a midchannel buoy with light and whistle, the "A" buoy. Thirteen pairs of buoys, with nine pairs lighted, mark the balance of the channel, which extends to the natural deep water southwest of Coney Island in the lower bay. Approaching the channel from Ambrose Light, a little more than three nautical miles to the southeast, water depths decrease from 90' just east of Ambrose Light to 60' within a mile and one-half of the "A" buoy, to about the mid-thirties at the entrance buoys and to the mid-twenties at the "2" and "3" buoys. On the Coney Island end of the channel, natural water depths range upwards from channel depth of approximately 42 feet to 80 and 90 feet in the vicinity of the Verrazano Bridge.

Ambrose Channel is well located for the approach and the exit at either end. On the sea buoy side, the center of the channel is almost directly in alignment with Ambrose Light. Although some maneuvering is usually required in and around Ambrose Light and the pilot boat area due to traffic convergence and pilot embarkation and disembarkation requirements, the channel location does not directly create maneuvering requirements. The western end

[15] See Chart Appendix B, p. 1B.

of the channel is equally well positioned for ship movements. The center is closely in alignment with the deep water of the lower bay and the center of the Verrazano Bridge, spanning the narrows.

Ambrose Channel usually presents a minimum of navigation problems. This in part is due to it's generous width and the requirement for only two basic course changes; and in part because of the general adequacy and symmetry of buoy placements throughout the channel. With respect to the latter point, except for an area between the entrance buoys ("2A" and "1A") and the N"2" and "C1" buoys, the remainder are stationed at one-half mile intervals. The closeness of the buoys and the consistency of their stationing is helpful, particularly in reduced visibility, in "fixing" the ship's longitudinal and lateral position in the channel and in adjusting distance off the "edge" of the channel.

The following discussion is presented to provide a general understanding of the types of information pilots use in navigating Ambrose and other dredged channels and how the information is used in maneuvering decisions.

During the inbound transit from sea the pilot, upon assuming the conn, will immediately adjust heading, as needed, to approach either the "A", or the entrance buoys depending on ship's position at the time. In all probability the ship will be headed towards the channel because of actions taken by the master after the pilot launch safely leaves the ship and prior to the pilot's arriving on the bridge. In conditions of good visibility the pilot's steering orders will be based on visual sightings of the entrance buoys, known course headings, or both. In restricted visibility, when the buoys cannot be immediately sighted, the pilot will use the radar to establish own ship's position relative to the "A" buoy, Ambrose Light Tower, the entrance buoys and any other traffic. He will then issue steering orders to permit a safe approach to the channel. In the event that the ship's radar is not working and he cannot observe a navigation mark immediately, but has sufficient visibility to continue the transit, he will steer to bring a leading mark into visual and auditory range. Engine speed will be adjusted to meet conditions of visibility, traffic and efficiency of transit time.

To digress briefly, it should be noted that pilots use radar information primarily in reduced visibility conditions for general navigational orientation of the type noted above, the identification of traffic movements, and as an aid in anchoring. Although on some ships the radar installations are capable of presenting information that can be used to accurately assess risk of collision, the radar is rarely, if ever, used for this purpose by pilots. Many reasons exist among pilots for not fully utilizing, or depending on the radar presentation as a primary information source, if any other information is available. Perhaps first and foremost is the relative lack of standardization that exists from one radar installation to another. In a busy port like New York, pilots see the entire spectrum, including installations dating from the "year one" to the most sophisticated computer aided devices currently coming on the market, PPI display sizes may vary from six inches to 16"; the display presentation may be stabilized in azimuth, or unstabilized in azimuth; the display may present ship's head up, north up, or base course up; presentations may include track history, or no track history information; the display may have single bearing rings or double bearing rings, often with different functions for different display presentation modes. The installation may be a 3 CM or 10 CM and usually both are included. And to add a little more variability, installations may include various combinations and premutations of all these and other characteristics.

For the short time periods available to the pilot during a transit, he is hardly able to begin to sort out all the characteristics of a particular set. Furthermore, by virtue of the fact that even the "knobs" lack any semblance of standardization, pilots make it a practice to never turn on, or adjust the equipment. They will always ask the master or the mate to turn it on, adjust brightness, change the range and so on. Because of these practices the pilot is afforded little or no opportunity to learn or practice using the more sophisticated capabilities of improved systems.

Still other impediments to the full utilization of the radar's information capabilities by pilots result from the general unavailability of "daylight" displays at normal conning positions. Standard PPI displays must be hooded in daylight to avoid the presentation being wiped out by the relatively stronger ambient light. Such requirements can interfere with time-sharing the radar presentation with the visual scene. For example, on some ships this requirement results in the radar being located in a remote part of the bridge surrounded by black curtains extending from deck to overhead. For all the above reasons, it is difficult for the pilot to make effective use of the full capabilities of radar equipments for the entire range of navigation and collision avoidance problems.

As positive identification is established with one or more of the aids to navigation in the area, the pilot steers to intercept the known course heading for the channel. Upon approaching the entrance buoys, he will be on a heading approximating the known true course for the channel. Depending on traffic, ship size, handling characteristics, and the visibility conditions, he may steer for the middle or right inside or outside quarter of the channel.

The immediate navigation problem is to determine the current set and drift[16] being experienced by the vessel. If the range provided by the West Bank Light and the fixed lights on Staten Island are visible, the problem is easily resolved. By steering a course that maintains the three lights in perfect alignment, current set and drift is automatically compensated for and the ship is advancing on a track line exactly in the center of the channel. By "cracking" the range lights open right or left, the track line is moved left or right, respectively, of the centerline of the channel. By referencing the range and one or a line of channel markers, the pilot can adjust lateral position in the channel to any desired track he wishes to maintain in the first leg of the channel.

In reduced visibility, correcting for current set and drift requires a trial and error procedure.[17] Based on his local knowledge and reference to the tide and perhaps tidal current tables, for the date and time of day, the pilot can reasonably predict the direction and strength of the current flow

[16] In marine navigation, the term current includes all external forces that introduce geographical error in the dead reckoning of the vessel. Thus, wind forces are included in the definition of the term. Set is used to indicate direction and drift to indicate speed.

[17] In all probability the pilot checked the tables prior to boarding.

relative to the channel and most likely the approximate effects on the vessel, considering it's draft. (Generally, the deeper the draft, the greater the current effects.) Wind forecasts for the area and whatever direct observational information that is available will permit an initial estimate of wind effects on the sail area of the vessel. In conversation with the master or mate, he will establish the probable amount and direction of error in the gyro compass. Also, since current set and drift is related to speed through the water (generally the slower the speed through the water the greater the effects of current set and drift) he will obtain a speed estimate, probably by relating engine RPM to posted speed tables, or by questioning the master or mate regarding this relationship. With this information at hand, plus present gyro heading and the known true course heading for the channel, the pilot can now estimate and order a course heading to compensate for the current set and drift. As an illustration, suppose the wind and current are both against the port bow and in combination are exerting significant forces against the ship. In this situation, if the pilot steers the known true course of the channel (296°), the ship eventually will be forced out of the channel or aground on the starboard side. Corrective action requires "crabbing" the ship's head to port a sufficient amount to permit the pivot point of the ship to proceed along the true course line of the channel. Thus, the pilot must steer a gyro compass course of something less than 296° in order to maintain a track parallel with the channel buoys, as he proceeds up the channel. Depending on how accurately he reads the effects of set and drift and the amount of precision he feels he needs for the situation, he may need two or more heading adjustments to arrive at a satisfactory track.

By continuing to watch his track line relative to the channel markers, he may make further heading adjustments to establish and maintain a different lateral position in the channel. As an aid in adjusting lateral position, he bears in mind that 1° of course change equals 100 feet of lateral movement in one mile. Thus, if he judges that he should adjust course to bring him 50 feet closer to the edge of the channel, he may steer 2° to the right of present gyro heading and observe his position off the next buoy, which he knows to be one-half mile ahead. Once the new lateral position in the channel is established, he can then once again apply, or reestablish, the correction for set and drift to maintain a parallel track with the channel markers. Of course, current set and drift may be variable from one reach to another and even within a reach. Consequently, the pilot is continuously alert for the need to make heading adjustments in order to maintain the desired track over the bottom.

Earlier, possible gyro compass error was mentioned as a factor in channel navigation. Errors of one-half to two degrees are not uncommon on inbound ships and the pilot usually learns from the master the probable error early in the transit and subsequently verifies it against natural or established ranges for which he knows the true course heading. Gyro compass error, if any, is taken into account in issuing all heading orders.

Longitudinal position in the channel is usually established by noting each pair of buoys as the vessel passes. From the N"2" through the R"18" buoy the spacing is at one-half mile intervals. This characteristic also makes time and speed calculations easy and pilots often use one or both in reduced visibility. Overall, the visual scene and normal patterning of objects within the scene become overlearned, often to the point that the presence or absence of an object not normal to the scene from a particular position in the channel will act as a stimulus to alert the pilot to a situation demanding immediate attention. A buoy may be off station, a small boat may be in or approaching the channel and so on.

By the time the vessel approaches the turn at the R"10" buoy the pilot has added significantly to his transit specific information.[18] He knows current set and drift and the way it will probably affect the vessel in the next leg of the channel. He may know the compass error and it's correction for the true course of the next leg. He knows the approximate speed being made through the water and over the bottom and likely has developed sufficient experience with the handling characteristics of the vessel in these conditions that he can accurately predict it's response to the rudder. He has observed both the ship and crew response times and thus can anticipate the lead time he must include in helm and perhaps engine orders. He also knows about the traffic he is going to meet and where passing situations are likely to develop. This type of transit specific information is clearly important for the decisions that must be made as the turn is approached: Where to start the turn; how much wheel should be ordered; should engine RPM's be increased or reduced to provide an extra margin of safety; where should the vessel be positioned laterally in the channel at the completion of the turn, considering present position, traffic, and the fact that another turn is just beyond this one? Although these and many other decisions will be largely based on the transit specific information the pilot has been accumulating, it must be remembered also that such transit specific information interacts with the pilot's local knowledge. The fact that he has made this turn hundreds of times before, in

[18] See Chart Appendix B, p. 3B.

a wide variety of situations and on many different ships, has provided a "learning curve" for the turn. He may "know", for example, that under the prevailing circumstances he should delay starting the turn, initiate it with 10° right rudder allowing the ship to move towards the centerline of the channel, add additional rudder as he reaches the center and finally steady on a course that, when compensated for set and drift, keeps the vessel near the center of the channel until he is ready to start the next turn; which he intends to initiate early so it can be completed well on his side of the channel in consideration of outbound traffic. Of course, the above statement is entirely hypothetical. The pilot has learned to make the turn under these general conditions with this type of ship and the likelihood that he is doing this kind of advanced planning is near certainty.

Under conditions of restricted visibility the turn, of course, becomes decidedly more difficult to negotiate. With visibility reduced to, let us say, just below one-half mile, it may become impossible to see more than one buoy at a time. Thus, the pilot will try to use a combination of different information sources to judge and maintain the desired track in the channel. A principle source in this situation is the radar presentation. With the radar he can observe his general position in the channel with respect to the buoys and if he had to he could probably negotiate the turn with this information alone. However, pilots, as are all deck officers, are well aware of the risks associated with depending on a single information source for any critical navigation maneuver. Thus, they will seek verification of position information from two or more independent sources whenever possible. In this instance the pilot will try to verify the information from the radar presentation by a visual sighting of the buoys; by comparing the known course of the reach against the ship's gyro compass heading, corrected, naturally, for error and expected current set and drift; perhaps, also, by time and distance calculations; by observing the rudder angle indicator and/or changes in vibration characteristics of the ship, one or both of which may signify an approach to the edge of the channel; by observing the change in "angle of attack" of the sea against the ship; by listening to the "clicking" of the gyro; and perhaps if he is still not satisfied, he may go out on the bridge wing and try to pick up the audible gongs, bells or whistles of the turning buoys.

As the ship approaches the R"16" buoy, the pilot must become additionally alert for potential traffic merging from the Chapel Hill North Channel. Still farther up towards the Narrows, even more alertness is usually evidenced by pilots due to the likelihood of increased tugboat and barge traffic. In this area tugs may be crossing the traffic lanes, shortening hawsers, or making up to push their tows. Furthermore, according to pilot reports, marginal visibility conditions can change dramatically in the vicinity of the Verrazano Bridge, either closing down, or opening due to local atmospheric effects associated with the bridge. The approach to the bridge also signals speed reductions, not only for the above reasons, but also because docking tugs are usually waiting in the area of the "20A" buoy to board the docking pilot. Additionally, ships in the Stapleton Anchorage often have barges alongside and excessive wakes can cause damage. Finally, the normal reduction of headway on very large ships requires significant time and distance to accomplish.

The ordered speed throughout the transit may be based on one or several situational factors: Vessels entering the port and proceeding directly to a dock usually have an ETA for arrival. Arriving early or late may result in placing an added cost burden on the vessel. The pilot is usually made aware of these schedules and will, within prudent limits, order speed adjustments accordingly. Seriously reduced visibility conditions call for a reduction of speed to insure the safety of the vessel. Traffic conditions may influence speed. In cases where a queue of three or more inbound vessels develops, the slowest vessel ordinarily will set the pace for the others. Passing arrangements are sometimes made from a two ship queue, but only when both pilots are in accord that it can be done safely. Ambrose Channel is sufficiently wide that one whistle passing situations rarely call for speed reductions on either vessel. In other areas of the harbor, however, speed reductions to minimize suction effects are the rule. The size, draft and handling characteristics of the vessel may call for speed reductions. Occasionally, also, a propulsion system may have a "critical" RPM range that is unusable due to undesirable vibrations; requiring the pilot to order speeds above or below, but not within the critical area. The lateral position in the channel may also interrelate with ordered speed. Excessive speed when the vessel is close in to the edge of the channel may result in a sheer and loss of control. Finally, a pilot may reduce RPM's when approaching a turn, or other critical maneuver, in which he feels a need to have a reserve of propulsion power to be able to give the vessel an extra "kick", or twisting movement, at any point in the maneuver.*

2. The Upper Bay

Most ships entering the Upper Bay will require tugboat assistance. The ship owner through office personnel or a port agent, arranges for the service with a local towing company. As the ship's ETA at the Verrazano Narrows Bridge becomes known, the towing company dispatches one or more tugboats, as required, to assist with the escort and docking operations. The number of tugs to be assigned is usually planned in advance by the docking pilot who will handle the job. He takes into consideration the overall size of the ship, it's draft, it's known or expected handling characteristics, the transit route, the water depths and current conditions he anticipates at the dock upon arrival and any expressed requirements from the shipping company and/or the master.

Each local towing company offering ship movement services employs persons with federal piloting endorsements with unlimited tonnage for the areas being serviced. For the most part, these docking pilots serve as captains on one of the companies' tugboats[19] and do a variety of other kinds of harbor work as well as the ship work. Although work schedules can vary between and within towing companies depending on work loads and other factors, tugboat crews usually work seven days on and seven off with watch schedules of six hours on and six off. Needless to say, perhaps, this kind of exposure to the harbor can lead to a level of local knowledge that includes the most exacting detail. Still another exposure factor involves the number of ships the docking pilot may handle in a given period of time. In New York the active bar pilots outnumber active docking pilots by approximately 5-1. This ratio appears to carry over into ship movements as well, with each docking pilot handling approximately five ships for every ship handled by a bar pilot.

[19] Some towing companies who do a high percentage of the ship movement work employ "office pilots", i.e., pilots who do only ship work and thereby work out of the companies' local office.

As the vessel moves into the near proximity of land on either side of the Narrows and into the Upper Bay, increasing possibilities exist for using natural[20] aids to navigation for position fixing, observing for set and drift, and estimating headway. An almost infinite number of natural ranges exist in the sense that any two fixed objects that can be readily observed can serve as a range for various purposes. The most generally useful range for navigation is the one that can be used as a steering aid for maintaining the desired track over the bottom. As one steers on such a range, set and drift are taken care of by the simple expedient of remaining on the range. In the case of natural steering ranges, certain characteristics are desirable, such as the objects should be readily and unmistakably identifiable, they should be in a known alignment when the vessel is positioned on the desired track, and they should be visible both day and night. Some variability exists among pilots with respect to the natural ranges they select and use in various parts of the harbor. The more prominent natural ranges are known and probably used by all or most pilots working the area regularly. This is particularly true, we suspect, in areas with a paucity of natural ranges as opposed to areas offering a wide number of possibilities.

Natural and established ranges may be used for many purposes. For example, most pilots heading north on the west side of Governors Island, intending to pass between the Battery and the Island, will reference the natural range formed by the Battery Tunnel ventilator located on the northeast corner of the Island

20As used herein a natural aid to navigation refers to prominent landmarks, buildings, towers, stacks, lights, etc. that although useful for navigation were not officially established or intended for that purpose. Established, or artificial, ranges are a part of the aids to navigation system officially established and maintained by the U. S. Coast Guard.

and a prominently spired building in Brooklyn as an aid for starting the turn. When the established range on the Brooklyn pier comes into view, it is used to complete the turn and navigate between the Battery and Governors Island.[21] Ranges are frequently used to fix and maintain lateral position in the channel. In some areas the process is rather involved. For example, in navigating around Shooters Island, just south of Newark Bay, the currents are often tricky and pilots may use a beacon, a watertank and a building that happens to be prominently marked with the word SINGER, as natural ranges. If the beacon and watertower are in alignment with the vessel's track, the pilot knows he is on the right hand side of the channel. As the beacon appears to progressively move across the letters of the word SINGER on the adjacent building, he knows he is moving toward or is in the left hand side of the channel. Ranges also serve in identifying danger bearings; establishing the limits of shoal areas; for observing current set and drift; for estimating headway and sternway during docking and undocking maneuvers; and to identify the approach heading and let go points for anchoring.

In view of the importance of ranges to navigation in very confined waters, there are surprisingly few established ranges in New York Harbor. At least two ranges, the Port Richmond and the Elizabethport, were allowed to deteriorate, or be destroyed over the years, and are no longer in place.[22] In still other areas the established range is maximally useful in only one transit direction. When going away from the range, the pilot is required to go out on the bridge wing to view the range astern of the ship. Having to do this is not simply an inconvenience for the pilot, but can add to the risks of the transit. In the way of illustration, consider the Poorhouse Flats Range located

[21]See Chart, Appendix B, p. 5B.
[22]See Chart, Appendix B, pp. 11B, 12B.

on the shore line just south of Newtown Creek in the East River.[23] The deep water in this area is on the Brooklyn shore from the Williamsburg Bridge north to a point just below Newtown Creek, it then cuts diagonally across the river to the Manhattan shore. The range was established to assist vessels in following the deep water across this area. Since it is located on the Brooklyn shore, it is maximally useful to the southbound traffic. To use it when northbound requires that the pilot leave his conning position in the wheelhouse and go out on the bridge wing. In doing so the pilot must move from the most desirable conning position to a less desirable one. This movement from one conning position to another can result in a momentary loss of orientation, distract attention from the conn, or both; particularly if it is a hazy night, there is traffic in the area and the ship has significant visibility obstructions forward of the wheelhouse. Finally, it is most often the northbound vessel that is loaded, southbounders are usually in ballast and water depths are not so critical. In their attempts to adapt to this situation, northbound pilots try to use a natural range formed by a smoke stack and the Chrysler Building. This range is quite satisfactory in good visibility conditions. However, again, on hazy nights it is difficult or often impossible to use since neither the building or the stack have lights.

Still other problems with established ranges were observed during the study period. The Port Socony Reach Range was unlighted for a two day period on one visit and the Battery Range located on Pier 2 Brooklyn was effectively blocked by a vessel moored to the end of the dock for a three day period on another visit.[24] Of course, these may be and probably are unusual occurrences. Nevertheless, such observations when taken along with the noted paucity of

[23] See Chart, Appendix B, p. 5B.
[24] See Charts, Appendix B, pp. 13B and 5B respectively.

established ranges throughout the area, raises questions about the relative priorities being given to such important aids to navigation.

When the docking pilot comes aboard he usually advises the master on the essentials of the escort and docking maneuvers. By way of illustration, he may tell the master that his two tugs are being positioned on each bow and he would like to have someone on deck take up their lines and secure them. He may add further that when they arrive at the dock, he wants the ship's forward spring lines out first, followed by the after springs, or vice versa, depending on the current and wind conditions he anticipates.

The tug escort operation is essentially a safety procedure. Ordinarily, the tugs follow along with the vessel to the dock without exerting any significant maneuvering forces. In the words of one docking pilot, "they are like life preservers, when you need them, you need them bad." With one or more lines up to a bit or chock on the ship, they can be held (against current and wind forces) in almost any position required to exert maneuvering forces on the ship as needed. On medium to large size ships two tugs are usually assigned. On very large ships, e.g., the SL-7 class, four large tugs are routinely assigned. Such assignments and the positioning of the tugs along the ship may vary with the anticipated transit conditions. With two tugs assigned, they are usually positioned on either bow during the escort part of the transit. With minimum headway being maintained, the effectiveness of the ship's engine(s) and rudder(s) for controlling the bows is often seriously reduced. The presence of the tugs on the bows permit better control of the forward position of the ship as well as assistance in emergency stopping situations. When it is anticipated that more control is desirable over the stern of the ship than can be provided by the engine(s) and rudder(s) alone, one or more tugs may be positioned aft. In the case of SL-7 ships, for example, two tugs are positioned on the bows and two are positioned aft; with one on either the starboard or port quarters (depending on the anticipated direction of current set) and one with a line up to the stern. The tug on the stern may respond "automatically" to each helm order by moving to the appropriate side and pushing with a force generally proportional to the order given, i.e., a small rudder angle order will call for moderate tug forces, while a hard over order will call for full power from the tug.

As the docking pilot directs the movements of the ship over the route to the dock, he will most probably try to follow a known track over the bottom. In this way he is least likely to be "surprised" by a developing siltation problem and/or unexpected traffic conditions that may require excessive maneuvering. His primary information source for maintaining the track is based on his local knowledge of the aids to navigation, landmarks and fixed natural ranges. He has also been acquiring transit specific information relative to the vessels handling characteristics, helm and engine response times, visibility and weather conditions, etc.

Traffic is a continuing source of concern in the relatively congested and narrow channels of the Upper Bay. The VHF radio and the bridge to bridge communication practices used by vessels transiting the area, is of primary importance in making traffic assessments and planning for meeting and passing situations. The practice of issuing security calls, i.e., announcing a vessel's position and other pertinent information at given reporting points, is standard for the larger vessels. Upon hearing a security call, the pilot in most situations can immediately determine whether a passing situation is likely to develop and if so where. In instances where a meeting or passing situation is developing, the pilot will usually respond to the announcing vessel with his own position and intentions. From such communications, the two pilots are made aware of each other's presence and can proceed to work out a safe passing. In many areas of the Upper Bay the combination of constraints placed on the situation by the respective ship sizes and the size of the channel make passings unsafe or impossible. Thus, part of the meeting arrangements may include one or both vessels reducing speed to permit passing in an area that insures the opportunity for a safe passing. Another common VHF communications practice used by the pilots in identifying the presence of traffic coming against them is to establish contact with another vessel, known to be ahead of them, that is in a position to view parts of the waterway that are blocked from their view. In this way even though they may have missed a security call issued earlier, they still obtain advanced warning of an impending meeting situation. The tugboats and other harbor work boats are particularly useful in making this relatively informal traffic advisory system effective.

As the ship approaches the dock area, the pilot will begin to reduce speed in anticipation of arriving at the berth with only the minimum headway needed to maintain navigation control over the vessel. At low forward speeds it is often difficult or impossible to accurately judge the vessel's headway by simply observing the waterway ahead of the ship. Thus, the pilot will frequently observe objects on the shoreline, abeam of the ship, for these judgments. Depending on the current and wind conditions, which may be working with, against, or having no appreciable effects on the ship, the pilot will maneuver using a combination of engine, rudder and tug forces to stop the vessel's movement over the bottom in a position that is parallel, or nearly so, with the dock. From this position the tugs are used, with, hopefully, minimum assistance needed from engine and rudder, to push the ship to the dock. As the ship gets close enough, spring lines are passed to the linemen and made secure. Using the tugs to hold the ship to the dock and the on-board capstans to control the slack in the lines, the pilot can use the ship's engines, in combination with the lines, to position as required fore and aft alongside the dock. Once in position, spring lines are made taut, and head, stern and breast lines, as needed, are put out and secured. When all mooring lines are secured, the pilot's job is finished.

3. The Southway

The second major entrance to the Port of New York is through the Sandy Hook Channel, across the Raritan Bay to the shoreline of Staten Island and around the southernmost part of the Island to Arthur Kill at Perth Amboy, N. J. The route with it's several reaches is conveniently referred to simply as the Southway.[25] From the entrance buoys of the Sandy Hook Channel to Perth Amboy the distance is approximately 18 miles. Water depths are about 35 feet at mean low water with rises of approximately 5 feet at mean high water. Channel widths are variable along the route from 600 to 800 feet. The route is used often by tankships servicing the many oil and chemical terminals located "behind" Staten Island. The combination of the narrow channels, the normally deep draft of the inbound ships, and the relative lack of useful ranges and prominent landmarks makes the transit one of the most difficult in the port.

Ships inbound from sea with a destination berth requiring the transiting of the Southway may have to anchor for a period of time to wait for the proper tide and/or visibility conditions. Ideally, the ship starts the transit at the entrance buoys at a time on the rising tide that will permit the vessel to arrive at it's assigned dock just before high, slack water. Such conditions provide for maximum water under the keel throughout the transit route and at the dock. Further, the absence of significant tidal currents at the dock can contribute to the safety and efficiency of the docking operation. Existing and forecast visibility conditions along the route are more critical than for most other areas in the port to the timing of the transit. Usually, reduced visibility of one-half mile or less is sufficient to delay the start of the passage until conditions improve. Thus, when the pilot boards the vessel at the sea buoy, his first consultation with the master may well involve the scheduling of the transit.

[25] See Charts Appendix B, pp. 16B, 15B, 14B, 13B.

The navigation problems in the Southway are in principle the same as those for Ambrose: The pilot must be aware of the ship's lateral and longitudinal position in the channel at all times; he must be constantly aware of the effects of current set and drift and apply compensating heading corrections, as needed, to maintain the desired track over the bottom; speed adjustments must be made as required to insure adequate navigational control of the vessel, prevent avoidable wake damage to other vessels and property, and generally to insure a safe and efficient passage. Likewise, the information the pilot uses to solve the navigation problems and the general manner in which he uses it, is essentially the same as that required for transiting Ambrose Channel.

As the ship approaches the entrance buoys, the pilot will be generally steering a gyro compass heading approximating that of the known true course of the channel (308°).[26] In all probability he has checked with the master about known compass errors and has included in his steering orders the correction, if a need is indicated. He may also have included in the steering order an adjustment for estimated current set and drift. In all likelihood, he is entering on the flood tide which will tend to set the ship across the channel from the black to the red side. By observing wind conditions in relation to the sail area of the ship, the net effect of current and wind acting on the ship is estimated. As he proceeds into the channel, he continues to observe the channel markers for the purposes of adjusting his distance off the red side and establishing a track parallel with the markers. Unless there are unusual wind effects, the pilot expects to be setting to the red side at the entrance buoys, to the black side in the vicinity of the "6" buoy, and again to the red side in the first turn.

[26] See Chart Appendix B, p. 2B.

In reduced visibility, the pilot will be continuously crosschecking his visual sightings of the buoys with the radar presentation, the gyro course being steered and the known true course of the channel. He will also keep a close watch on the rudder angle indicator which can provide early warning of an approach to the edge of the channel. By correlating these relatively independent items of information, he is less likely to be misled by errors in any single source of information. For example, occasionally, one or more channel markers may be off station due to adverse weather effects, or by being struck by passing traffic. A need for excess wheel may be the first indication that something is wrong in the situation.[27] In effect, "two plus two must always equal four."

As the ship moves up the channel, the pilot, knowing the ship's draft and the approximate water depths at this stage of the flood tide, will be sensitive to the way it responds to helm orders and perhaps changes in vibration characteristics. Observing the engine RPM and correlated speeds, he may decide that by reducing squat and thereby increasing the water depth under the keel, the ship will handle better. As a rule of thumb, a ship squats, or sinks by the stern, about one foot for each 5 knots of speed. A ship "smelling" the bottom may react irradically to the irregularities of the bottom.

As the ship makes the turn into the western section of Sandy Hook Channel,[28] the pilot is likely to change his method of issuing steering orders from ordered headings to ordered rudder angles. In part this seems to be due to the less predictable currents in the area. By directly controlling the rudder angle, the pilot may feel a more immediate sense of control over the vessel and it's position in the channel. In part, also, it is probably due to his need to position the ship for the next turn. Pilots tend to bear towards the left side of the channel after passing Sandy Hook to "open" the turn at the R"18" buoy. Because

[27]See the transit of the Olympic Games. Appendix A, P. 79A.
[28]See Chart Appendix B, p. 15B.

of the tricky currents and the need to position for the turn into Raritan Bay, pilots try to avoid any passing situations in the west section of the channel. After making the turn into Raritan Bay, the pilot likely will return to issuing helm orders as courses to be steered. In this section of the channel, he is also likely to reduce engine RPM's. Such actions provide an additional reserve of power to break a sheer, or to provide an extra twisting force on the ship should it be needed for any reason.

Upon entering the east reach of Raritan Bay, the pilot will again estimate corrections in heading needed to compensate for current set and drift. By observing distance off the entrance buoys and later the N"4" buoy, the estimate is adjusted as needed. During the transit, he will continue to observe his position visually in relation to the channel markers, watch the rudder angle indicator, monitor the heading against the known true course, and where needed the radar presentation. Speed will be returned to the maximum permissible under the conditions.

In recent years the "9" buoy was added to the black side of the east reach of the channel.[29] Before that time there were no markers on that side of the channel between the "1" and "19" bouys, a distance of about 5-1/2 miles. Pilots acknowledge that the addition of the "9" buoy aids in judging position in the channel, particularly at night. It's greatest value is probably for the outbound vessel confronted with a passing situation. Although the pilots we had occasion to talk with have been somewhat non-committal about the adequacy of aids to navigation in Raritan Bay, it appears to this observer that, in relation to the other areas of the Southway and Ambrose, they must be judged as being only marginal.

[29]See Chart Appendix B, p. 14B.

At the "14" buoy the pilot is likely to reduce speed in anticipation of the turn at Seguine Point.[30] On large, deeply loaded vessels considerable time is required to reduce headway. When they can be seen, the pilot is usually attending to the relative position of beacon "20" and a smoke stack on Seguine Point as steering aids.

At the Seguine Point Bend the pilot picks up the established range at Red Bank as a steering aid for the turn. The bend has been dredged out on the red side allowing the pilot to steer a little to the right of the range if he needs to do so. The pilot may also further reduce speed as he approaches the turn to avoid pulling water from Lemon Creek where many pleasure craft are docked. Most ships will experience some bank effects on this turn. In extreme cases the effects are so strong that the pilot may be required to hold some right rudder while making this left hand turn.[31]

At Ward Point, several channels converge in a relatively small area.[32] Each channel including the Ward Point Bend is well marked with beacons and buoys leading to the nickname, the "buoy farm". Pilots appear to perceptually organize the patterns made by the various combinations of markers as an aid in identifying their position in the channel. For example, for one pilot the "49", "53", "54", "52" and "50" buoys form a "house with a gable on top."[33] Several combinations of beacons and buoys are used by different pilots as ranges for steering, locating lateral position in the channel, and/or checking the positioning of other buoys. Buoy "hopping" on the red side of the channel is hazardous because of a shoal area that extends into the channel between the "54" and "56" bouys.

[30]See charts Appendix B, pp. 14B and 13B respectively.
[31]See the transit of the Stawanda for an explanation of these effects. Appendix A, pp. 91A, 92A.
[32]See Chart Appendix B, p. 13B.
[33]See the transit of the Olympic Games, Appendix A, p. 85A.

For the lay person, at least, this must be the most confusing area in the port. From the R"46" buoy inbound, it is possible to see at one time at least 19 navigation marks and perhaps as many as 26. However, interestingly enough, after passing the "55" buoy at the western end of Ward Point Secondary Channel, there are no buoys on the black side of the channel until one reaches the C"5" buoy, which marks a submerged rock, off Woodbridge Creek, well above the Outerbridge Reach. Nor are there any established ranges for the Ward Point Bend West Reach and turn. Pilots use smoke stacks "cracked open" slightly, together and in combination, with apartment houses, etc., for navigating the area. If the area is confusing in the daytime, it must be particularly so at night when ships are using the anchorage at Ward Point Bend and other traffic is moving in the various channels.

4. Arthur Kill

The tugboats that will assist in the docking operations wait in the vicinity of Perth Amboy, N. J. and Tottenville, Staten Island, for inbound ships. Likewise, they usually terminate their assistance duties at this point for outbounders.

As the docking pilot takes the conn, he immediately positions the tugs, usually on either side of the bows, with lines up to the ship. This provides the pilot an added capability for controlling the forward part of the ship and emergency assistance for stopping and/or reducing the headway as the ship approaches the docking area.

Arthur Kill includes the nine reaches from the Outerbridge Reach to the North of Shooters Island Reach, located at the western entrance to Newark Bay. The advertised width is 500 feet and depths at mean low water are approximately 34 feet. Many of the ship movements in the area are high water jobs, i.e., timed to the extent practical to move on the rising tide and arrive at the dock just before the slack, high water.

Due to the close proximity of land throughout Arthur Kill, the pilot makes extensive use of the many natural and the few established ranges for steering the vessel. Normally, he will maintain a track over the bottom as near the center of the channel as traffic conditions permit. Siltation can be a problem and the channel tends to shoal along the edges.

Speed control is an important navigation problem. The relatively narrow channels, the many docks and piers along which ships and barges are moored, and the presence of traffic makes it mandatory that large vessels proceed slowly. The pilot is always alert to losing navigation control at reduced speeds and must be ready to use the ship's propulsion power in short bursts and/or tugboat forces to maintain his track line. Reference to ranges or land objects abeam of the ship provide the most reliable information about headway. As part of the speed control problem, the pilot must be, or quickly become, familiar with the characteristics of the vessel's propulsion system. The response time of the propeller to engine orders becomes critical in issuing orders. A slower than normal response time of the ship to engine orders must be compensated for by issuing the order sooner. On steam turbine ships the propeller may continue to turn slowly on a stop engine order, providing a measure of headway or sternway the pilot must anticipate and be prepared to deal with. A vessel with a variable pitch propeller must be slowed down carefully and even then the reduced propeller pitch can block the normal flow of water past the rudder resulting in a loss of steering control. As noted in another section of this report,[34] the propulsion control methods in standard use, "lump" the full range of engine RPM's, ahead and astern, respectively, into five engine orders: FULL, DEAD SLOW, SLOW, HALF and FULL. This characteristic often results in one order being too slow and the next option being too fast for the prevailing conditions.

The tidal currents in certain reaches add significantly to the navigation control problems. The narrow channels and the relatively tight turns often cause the currents to ricochet off the shoreline and into the ship in a manner the uninitiated may not be prepared to expect.[35] With the pilot's local knowledge and his experience in handling various size vessels in the area, he is prepared to anticipate these conditions and to position and otherwise maneuver the ship to counter and/or use these forces to his best advantage.

[34]The Engine Order System.
[35]See the transits of the Great Republic and the Arco Prestige.

Helm and engine orders, and particularly the former, must be carefully monitored in all narrow channels. Inexperienced and/or non-English speaking helmsmen are prone to become confused and turn the wheel the wrong way,[36] or to steer on a buoy or object on the shoreline while failing to take account of the current set.

Two fixed bridges and one lift bridge cross the Arthur Kill. The fixed bridges are the Outerbridge Crossing and the Goethals, with vertical clearances at mean high water of 143 feet and 137 feet, respectively. The lift bridge is the Arthur Kill Railroad Bridge with a vertical clearance at mean high water of 135 feet. Extra caution is required in approaching the lift bridge, particularly on a fair tide (which we have noted is standard conditions for the larger vessels), because of the always present uncertainty about when and if the bridge will be raised. Failures in the lifting mechanism, or excessive delays can ruin a pilot's day.

In the North of Shooters Island Reach the tidal currents flowing through the Arthur Kill, the Kill Van Kull and Newark Bay converge around the "17" and "18" buoys. Thus, a situation can exist where eastbound and westbound ships meeting each other can both be experiencing the same tide conditions, i.e., both can have a fair tide or both can be stemming the tide.

In this area, also, the aids to navigation change. Newark Bay is considered the port of call for placement of the aids to navigation. For the inbound transit to Newark Bay, from both Arthur Kill and the Kill Van Kull, the red aids are to the right hand.

[36] See the transit of the Stawanda, Appendix A, p. 93A.

5. Kill Van Kull

The Kills extend from the Constable Hook Reach at St. George, Staten Island to the Elizabethport Reach, Arthur Kill.[37] The ship channel is 600 feet wide and approximately 34 feet deep at mean low water. A large percentage of the ship traffic in the Kills is container ships going in and out of Port Elizabeth and Port Newark in the Newark Bay. For the most part these ships have drafts of less than 30 feet. Sealand's SL-7's are usually a little deeper, resulting in a policy on the companies' part of a minimum of 2 feet of water under the keel before the ship can be moved in or out.

Essentially the same types of navigation problems exist in the Kills as in other parts of the Upper Bay and in the Arthur Kill, and pilots, in principle, use the same types of information in about the same way for solving them. The reader is thus referred to those sections of the report and to the video recordings and written summaries of the six transits made in the area.

6. Newark Bay

For the purposes of this study, the Newark Bay extends from Bergen Point to Port Newark Terminal.[38] The channel width is variable from about 900 feet just north of Bergen Point to 600 feet in the Newark Bay Middle Reach. The channel depth is about 30 feet at mean low water. The channels into Port Elizabeth and Port Newark are about 500 feet wide, with depths of 25 feet and 24 feet, respectively, at mean low water. The more recently constructed container berths, south of the Elizabeth Channel, have water depths at the dock of about 35 - 38 feet. These berths are used by the largest and deepest container ships calling on the port.

[37]See Charts Appendix B, pp. 4B and 11B.
[38]See Chart Appendix B, p. 11B.

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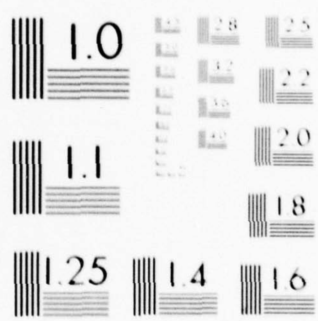

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Point turn and the passage through the Bay Draw Railroad Bridge. The turn around Bergen Point is about 110°. Currents running in the Kill Van Kull, Arthur Kill and Newark Bay tend to converge in the vicinity of the turn. The shore areas around the turn are rock. Given the combination of these factors, particularly under unfavorable wind and visibility conditions, makes the turn both difficult and hazardous for very large container ships. Good control over the track of the vessel must be maintained at all times. On the larger and deeper ships, which usually have to proceed at speeds that provide for only marginal navigation control, the use of tug forces for assistance in making the turn is standard procedure. For inbound ships the turn is further complicated by the need to be positioned, when the turn is completed, for passage through the Bay Draw. The Draw has two openings. The one that is usually opened is on the west side and has a horizontal clearance of 216 feet. The East Draw has a horizontal clearance of 134 feet. Both have vertical clearances when in the up position of 135 feet at mean high water.

The combination of the rise of the land at Bergen Point and the several oil storage tanks associated with a marine terminal on the Bay Draw side of the point, tends to effectively block visibility around the turn for ships inbound from the Kill Van Kull and outbound to the Kills. Pilots are therefore very much dependent on establishing VHF radio communications with traffic in the area to avoid awkward and dangerous passing situations.

The Bay Draw usually presents pilots with the most problems during the downbound transit. Frequently, vessels must hold above the bridge for significant time periods waiting for a scheduled train to cross the bridge. Ships leaving Port Newark and Port Elizabeth can usually plan their advance to the bridge to provide a reasonable safety margin. However, the larger vessels using the south end of the Elizabeth Port Authority Marine Terminal have much less distance in which to "expand time". Once they have undocked, significant delays in raising the Draw become increasingly troublesome, particularly on the ebb tide.[39] Still another factor of importance during the downbound transit is the wind conditions. The relatively unsheltered area of Newark Bay permits greater adverse wind effects on the vessels while positioning for and during passage through the bridge.

The pilot's local knowledge of the variable currents and wind effects are of primary importance in directing ship movements in this area. The ability to anticipate conditions and their probable effects accurately, appears to be a key factor in positioning a vessel for a particular series of maneuvers and in handling the general control problems confronting the pilot.

[39] See the transit of the Sealand Galloway.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. Basic Information Sources

Pilotage as performed by the professional pilot in the Port of New York and elsewhere, is largely a visually dependent activity involving a continuous series of actions and reactions to the transit situation. That is, most of the essential requirements of navigation are performed by the pilot's use of visual sightings of aids to navigation, natural ranges and prominent landmarks; vessel control actions are taken to maintain known tracks over the ground and/or to move the vessel from it's present position to the desired position.

Three classes of interacting sources of information form the basis for the decision process involved in directing vessel movements: Local knowledge; transit specific information; and knowledge of shiphandling techniques.

Local knowledge exists in the long term memory of the pilot and is subject to recall on demand and/or by situational factors. This local information is characterized generally as being of the type that appears on the nautical charts prepared for the area and in the memory of professional pilots who regularly work in the area. It is this local knowledge that permits the pilot to continuously maintain his orientation and accurately fix his vessel's position and track, and to understand and anticipate many of the dynamic characteristics of the enviornment.

Transit specific information is that which the pilot accumulates before and during a particular transit. It includes information about the actual dynamic characteristics of the environment, the ship, and their interactions under the conditions of a specific transit.

Shiphandling knowledge, of the three information sources identified, is clearly the most troublesome one to characterize. Our bias at this time, for several reasons including the fact that this study concentrated on observing professional pilots with extensive experience in shiphandling, is to view the knowledge as a background for most order decisions, and generally to relegate it to a level of lesser importance in the decision process than either local knowledge or transit specific information.

Observations suggest that the detail and accuracy of a pilot's local knowledge, and the types of transit specific information he acquires and the way he acquires it, are importantly related, both separately and in their interactions, to the quality of the decision process. It seems likely that errors from either or both sources can contribute to undesirable performance, that can often be confusingly labeled as shiphandling errors.

It is recommended that research is needed to clarify the role of these information sources and their interactions in the maneuvering decision process. Such work can be expected to have important implications for accident investigations and training program development.

B. Some Background Comments on Vessel Design

Vessel design characteristics were generally considered to be outside the purview of this study. Nevertheless, certain general observations are made about the relationships of the principle conning positions and the engine order system to vessel design characteristics. These observations are intended to provide the general reader some appreciation of the impact of bridge design on the safe navigation of vessels in pilotage waters.

1. Conning Positions

Observations tend to confirm the conclusions of other studies that pilots use five (5) basic conning positions for directing the movements of commercial oceangoing vessels: Position #1 is located directly in front of the bridgehouse window on the centerline of the ship. Positions #2 and #3 are located to the left and right of position #1, respectively, with the exact location of each dependent on obtaining an unobstructed view forward. Positions #4 and #5 are located on the extreme ends of the port and starboard bridge wings, respectively. Each of these positions are importantly related to the pilot's navigational information requirements in various transit situations.

The ability to identify pilot conning positions, based on the bridge visibility characteristics of a vessel, can serve as a useful aid for solving many difficult bridge design and instrumentation layout problems. Such identifiable positions can serve as a focus for locating bridge instrumentation providing important maneuvering information and control functions. To illustrate, conning position #1 is a key work area for the pilot while transiting areas where precise heading information is critical. If the pilot is required to move physically from this position to view the rudder angle indicator, or to insure that the helmsman is correctly following his last order, he can quickly lose his visual reference. Likewise, he should be able to easily see the gyro compass, the engine order telegraph, the propeller revolution tachometer, the fathometer and the rate of turn indicator if the vessel is so equipped; furthermore, he needs access to the VHF radio, the ship's whistle and perhaps the bowthruster.

Generally, the same instrumentation should be readily accessible at all three conning positions located inside the wheelhouse. During docking and undocking maneuvers when the pilot is at positions #4 and #5, the priority of the information and control instrumentation changes somewhat, but the principle remains the same: The pilot should not be required to physically leave the conning position to acquire important navigation information, to give orders and monitor their execution and to carry out directly certain actions, such as using the ship's whistle and the bow and stern thrusters if the vessel is equipped with them..

2. The Engine Order System

The layman who views the video tape recordings presented as a part of this study and listens carefully to the engine orders given by the pilots may well be puzzled by the archaic methods of propulsion control being used on modern ships. Statements by pilots, such as, "dead slow ahead is too slow and slow ahead is too fast" may be nearly incomprehensible to people who are use to the rather precise and direct control exercised over the propulsion power of other transportation systems. Likewise, observing the long chain of actions and reactions by people on the bridge and in the engine room required to control the propulsion system on most modern vessels is akin to looking back into the past.

Based on the limited observations from this study, it is concluded that the existing engine order system and propulsion control procedures used on most large ships fail to provide the opportunity for exercising the precision of control that is desirable in many pilotage situations and are generally vulnerable to system reliability errors. Propulsion control on most ships, including those with bridge control, can be significantly improved by standardizing and locating the instrumentation within easy viewing of all five conning positions. On ships with long bridges the need exists for a communications link between positions #4 and #5 and the EOT, or an appropriate repeater control station located at the conning position.

C. Major Transit Routes

1. Ambrose Channel

Ambrose Channel is the primary ship channel to the upper bay of New York Harbor. The channel is dredged to approximately 42 feet at mean low water, is 9.2 nautical miles long, 2000 feet wide and is marked on the eastern or seaward end with a midchannel buoy with light and whistle, the "A" buoy. Thirteen pairs of buoys, with nine pairs lighted, mark the balance of the channel, which extends to the natural deep water southwest of Coney Island in the lower bay. Although some maneuvering is usually required in and around Ambrose Light and the pilot boat area due to traffic convergence and pilot embarkation and disembarkation requirements, the channel location does not directly create maneuvering requirements. The western end of the channel is equally well positioned for ship movements. The center is closely in alignment with the deep water of the lower bay and the center of the Verrazano Bridge, spanning the narrows.

Ambrose Channel usually presents a minimum of navigation problems. This in part is due to its' generous width and the requirement for only two basic course changes; and in part because of the general adequacy and symmetry of buoy placements throughout the channel.

During the inbound transit from the seabuoy the pilot, upon assuming the conn, will immediately adjust heading, as needed, to approach either the "A", or the entrance buoys depending on ship's position at the time. In conditions of good visibility the pilot's steering orders will be based on visual sightings of the entrance buoys, known course headings, or both. In restricted visibility, when the buoys cannot be immediately sighted, the pilot will use the radar to establish own ship's position relative to the "A" buoy, Ambrose Light Tower, the entrance buoys and any other traffic. He will then issue steering orders to permit a safe approach to the channel. In the event that the ship's radar is not working and he cannot observe a navigation mark immediately, but has sufficient visibility to continue the transit, he will steer to bring a leading mark into visual and auditory range. Engine speed will be adjusted to meet conditions of visibility, traffic and efficiency of transit time.

As positive identification is established with one or more of the aids to navigation in the area, the pilot steers to intercept the known course heading for the channel. Upon approaching the entrance buoys, he will be on a heading approximating the known true course for the channel.

The immediate navigation problem is to determine the current set and drift being experienced by the vessel. If the range provided by the West Bank Light and the fixed range lights on Staten Island are visibile, the problem is easily resolved. By steering a course that maintains the three lights in alignment, current set and drift is automatically compensated for and the ship is advancing on a track line exactly in the center of the channel. By "cracking" the range lights open right or left, the track line is moved left or right, respectively, of the centerline of the channel. By referencing the range and one or a line of channel markers, the pilot can adjust lateral position in the channel to any desired track he wishes to maintain in the first leg of the channel.

In reduced visibility, correcting for current set and drift requires a trial and error procedure. Based on his local knowledge and reference to the tide and perhaps tidal current tables, for the date and time of day, the pilot can reasonably predict the direction and strength of the current flow relative to the channel and most likely the apprroximate effects on the vessel, considering it's draft. (Generally, the deeper the draft, the greater the current effects.)

Wind forecasts for the area and whatever direct observational information that is available will permit an initial estimate of wind effects on the sail area of the vessel. In conversation with the master or mate, he will establish the probable amount and direction of error in the gyro compass. Also, since current set and drift is related to speed through the water (generally, the slower the speed through the water the greater the effects of current set and drift) he will obtain a speed estimate, probably by relating engine RPM to posted speed tables, or by questioning the master or mate regardint this relationship. With this information at hand, plus present gyro heading and the known true course heading for the channel, the pilot can now estimate and order a course heading to compensate for the current set and drift. Depending on how accurately he reads the effects of set and drift and the amount of precision he feels he needs for the situation, he may need two or more heading adjustments to arrive at a satisfactory track.

Gyro compass errors of one-half to 2° are not uncommon on inbound ships and the pilot usually learns from the master the probable error early in the transit and subsequently verifies it against natural or established ranges for which he knows the true course heading. Gyro compass error, if any, is taken into account in issuing all heading orders.

Longitudinal position in the channel is usually established by noting each pair of buoys as the vessel passes. The buoys are also used for time and speed calculations if the pilot feels he needs this information. Overall, the visual scene and normal patterning of objects within the scene become overlearned, often to the point that the presence or absence of an object not normal to the scene from a particular position in the channel will act as a stimulus to alert the pilot to a situation demanding immediate attention. A buoy may be off station, a small boat may be in or approaching the channel and so on.

By the time the vessel approaches the turn at the R"10" buoy the pilot has added significantly to his transit specific information: He knows current set and drift and the way it will probably affect the vessel in the next leg of the channel; he may know the actual compass error and it's relative correction for the true course of the next leg; he knows the appropriate speed being made through the water and over the ground; he has sufficient experience with the handling characteristics of the vessel in these conditions that he can reasonably anticipate the rudder power; he knows something of both the ship and crew response times and thus the lead time he must include in helm and perhaps engine orders; and he knows about the traffic he is going to meet and where passing situations are likely to develop. This type of transit specific information is clearly important for the decisions that must be made as the turn is approached. These and many other decisions, for the balance of the transit, will be based on the transit specific information the pilot has been accumulating as it interacts with his local knowledge.

With visibility reduced to, let us say, just below one-half mile, it may become impossible to see more than one buoy at a time. Thus, the pilot will try to use a combination of different information sources to judge and maintain the desired track in the channel. A principle source in this situation is the radar presentation. With the radar he can observe his general position in the channel with respect to the buoys. However, pilots, as are all deck officers, are well aware of the risks associated with depending on a single information source for any critical navigation maneuver. Thus, they will seek verification of position information from two or more independent sources whenever possible. In this instance the pilot will try to verify the information from the radar presentation by a visual sighting of the buoys; by comparing the known course of the reach against the ship's gyro compass heading, corrected, naturally, for error and expected current set and drift; perhaps, also, by time and distance calculations; by observing the rudder angle indicator and/or changes in vibration characteristics of the ship, one or both of which may signify the approach of the edge of the channel; by observing the change in "angle of attach" of the sea against the ship; by listening for audible sound from the gyro; and perhaps if he is still not satisfied, he may try to pick up the audible gongs, bells and whistles of the turning buoys.

As the ship approaches the R"16" buoy, the pilot must become additionally alert for potential traffic merging from the Chapel Hill North Channel. Still farther up towards the Narrows, even more alertness is usually evidenced by pilots due to the likelihood of increased tugboat and barge traffic. In this area tugs may be crossing the traffic lanes, shortening hawsers, or making up to push their tows. The approach to the Verrazano Bridge and the Upper Bay signals speed reductions, for several reasons, including the fact that the normal reduction of headway on very large ships requires significant time and distance to accomplish.

The ordered speed throughout the transit may be based on one or several situational factors: 1) The pilot is usually made aware of the vessel's ETA and will, within prudent limits, order speed adjustments accordingly. 2) Reduced visibility conditions call for a reduction of speed to insure the safety of the vessel. 3) Traffic conditions may influence speed. In cases where a queue of three or more inbound vessels develops, the slowest vessel ordinarily will set the pace for the others. Passing arrangements are sometimes made from a two ship queue, but only when both pilots are in accord that it can be done safely. 4) Speed reductions are often ordered to minimize suction effects with passing vessels. 5) The size, draft and handling characteristics of the vessel may call for speed reductions. 6) A propulsion system may have a "critical" RPM range that is unuseable due to undesirable vibrations. 7) Speed may be reduced when the vessel is close in to the edge of the channel to avoid a possible sheer and loss of control. Finally, a pilot may reduce RPM's when approaching a turn, or other critical maneuver, in which he feels a need to have a reserve of propulsion power to be able to give the vessel an "extra" kick, or twisting movement, at any point in the maneuver.

2. The Upper Bay

Most ships entering the Upper Bay require tugboat assistance. The number of tugs to be assigned is usually planned in advance by the docking pilot who will handle the job. He takes into consideration the overall size of the ship, its' draft, its' known or expected handling characteristics, the transit route, the water depths and current conditions he anticipates at the dock upon arrival and any expressed requirements from the shipping company and/or the master.

As the vessel moves into the near proximity of land on either side of the Narrows and into the Upper Bay, increasing possibilities exist for using natural (prominent landmarks, buildings, etc.) aids to navigation for position fixing, observing for set and drift, and estimating headway. An almost infinite number of such natural ranges exist in the sense that any two fixed objects that can be readily observed can serve as a range. The most generally useful range for navigation is the one that can be used as a steering aid for maintaining the desired track over the bottom. As one steers on such a range, set and drift are taken care of by the simple expedient of remaining on the range. In the case of natural steering ranges, certain characteristics are desirable, such as the objects should be readily and unmistakably identifiable, they should be in a known alignment when the vessel is positioned on the desired track, and they should be visible both day and night.

Natural and established (a part of the official aids to navigation system) ranges may be used for many purposes: to fix and maintain position in a channel; as an aid in determining when to start a turn; to identify danger bearings; for observing current set and drift; for estimating headway and sternway; to identify the approach heading and let go points for anchoring.

In view of the importance of ranges to navigation in very confined waters, there are surprisingly few established ranges in New York Harbor. At least two ranges, the Port Richmond and the Elizabethport, were allowed to deteriorate, or be destroyed over the years, and are no longer in place. In still other areas the established range is maximally useful in only one transit direction. When going away from the range, the pilot is required to go out on the bridge wing to view the range astern of the ship. Having to do this is not simply an inconvenience for the pilot, but can add to the risks of the transit. In the way of illustration, consider the Poorhouse Flats Range located on the shoreline just south of Newton Creek in the East River. The deep water in this area is on the Brooklyn shore from the Williamsburg Bridge north to a point just below Newton Creek, it then cuts diagonally across the river to the Manhattan shore. The range was established to assist vessels in following the deep water across this area. Since it is located on the Brooklyn shore, it is maximally useful to the southbound traffic. To use it when northbound requires that the pilot leave his conning position in the wheelhouse and go out on the bridge wing. In doing so the pilot must move from the most desirable conning position to a less desirable one. This movement from one conning position to another can result in a momentary loss of orientation, distract attention from the conn, or both; particularly if it is a hazy night, there is traffic in the area and the ship has significant visibility obstructions forward of the wheelhouse. Finally, it is most often the northbound vessel that is loaded, southbounders are usually in ballast and water depths are not so critical. In their attempts to adapt to this situation, northbound pilots try to use a natural range formed by a smokestack and the Chrysler Building. This natural range is quite satisfactory in good visibility conditions. However, again, on hazy nights it is difficult or often impossible to use since neither the building or the stack have lights.

Still other problems with established ranges were observed during the study period. The Port Socony Range was unlighted for a two day period on one visit and the Battery Range located on Pier 2 Brooklyn was effectively blocked by a vessel moored to the end of the dock for a three day period on another visit. Of course, these may be and probably are unusual occurrences. Nevertheless, such observations when taken along with the noted paucity of established ranges throughout the area, raises questions about the relative priorities being given to such important aids to navigation

As assisting tugboats come alongside the ship, the docking pilot boards and relieves the bar pilot of his responsibilities. He usually advises the master immediately on the essentials of the escort and docking requirements.

The tug escort operation is essentially a safety procedure. Often the tugs follow along with the vessel to the dock without exerting any significant maneuvering forces. With one or more lines up to a bit or chock on the ship, a tug can be held (against current and wind forces) in almost any position required to exert maneuvering forces on the ship as needed.

As the docking pilot directs the movements of the ship over the route to the dock, he will most probably try to follow a known track over the bottom.

In this way he is least likely to be "surprised" by a developing siltation problem and/or unexpected traffic conditions that may require excessive maneuvering. His primary information sources for maintaining the track is his local knowledge of the channel position, the aids to navigation, landmarks and natural ranges. He has also been acquiring transit specific information relative to the vessel's handling characteristics, helm and engine response times, visibility and weather conditions, etc.

Traffic is a continuing source of concern in the relatively congested and narrow channels of the Upper Bay. The VHF radio and the bridge to bridge communication practices used by vessels transiting the area, is of primary importance in making traffic assessments and planning for meeting and passing situations.

As the ship approaches the dock area, the pilot will begin to reduce speed in anticipation of arriving at the berth with only the minimum headway needed to maintain navigation control over the vessel. At low speeds it is often difficult or impossible to judge headway and current set and drift. Thus, the pilot will frequently observe objects on the shoreline, abeam of the ship, for these judgments. Depending on the current and wind conditions, the pilot will maneuver using a combination of engine, rudder and tug forces to bring the vessel into a dead over the ground position that is parallel, or nearly so, with the dock. From this position the tugs are used, with, hopefully, minimum assistance needed from engine and rudder, to push the ship to the dock. As the ship gets close enough, spring lines are passed to the linemen and made secure. Using the tugs to hold the ship to the dock and the on-board capstans to control the slack in the lines, the pilot can use the ship's engines, in combination with the lines to position as required fore and aft alongside the dock. Once in position, spring lines are made taut and head, stern and breast lines, as needed are put out and secured.

3. The Southway

The second major entrance to the Port of New York is through the Sandy Hook Channel, across the Raritan Bay to the shoreline of Staten Island and around the southernmost part of the island to Arthur Kill at Perth Amboy, N.J. The route with its' several reaches is conveniently referred to simply as the Southway. From the entrance buoys of the Sandy Hook Channel to Perth Amboy the distance is approximately 18 miles. Water depths are about 35 feet at mean low water with rises of approximately 5 feet at mean high water. Channel widths are variable along the route from 600 to 800 feet. The route is used often by tankships servicing the many oil and chemical terminals located "behind" Staten Island. The combination of narrow channels, the normally deep draft of the inbound ships, and the relative lack of useful ranges and prominent landmarks makes this transit one of the most difficult in the port.

Ideally, a ship starts the transit at the entrance buoys at a time on the rising tide that will permit the vessel to arrive at its' assigned dock just before high, slack water. Such conditions provide for maximum water under the keel throughout the transit route and at the dock, and the absence of significant tidal currents during docking. Existing and forecast visibility conditions along the route are more critical than for most over areas in the port to the timing of the transit.

The navigation problems in the southway are in principle the same as those for Ambrose: The pilot must be aware of the ship's lateral and longitudinal position in the channel at all times; he must be constantly aware of the effects of current set and drift and apply compensating heading corrections, as needed, to maintain the desired track over the bottom; speed adjustments must be made as required to insure adequate navigational control of the vessel, prevent avoidable wake damage to other vessels and property, and generally to insure a safe and efficient passage. Likewise, the information the pilot uses to solve the navigation problems and the general manner in which he uses it, is essentially the same as that required for transiting Ambrose Channel.

In recent years the "9" buoy was added to the black side of the east reach of the Raritan Bay channel. Before that time there were no markers on that side of the channel between the "1" and "19" buoys, a distance of about 5-1/2 miles. Pilots acknowledge that the addition of the "9" buoy aids in judging position in the channel, particularly at night. Its greatest value is probably for the outbound vessel confronted with a passing situation. Although the pilots we had occasion to talk with have been somewhat non-committal about the adequacy of aids to navigation in Raritan Bay, it appears to this observer that, in relation to the other areas of the Southway and to Ambrose, they must be judged as being only marginal.

At Ward Point, several channels converge in a relatively small area. Each channel including the Ward Point Bend is well marked with beacons and buoys leading to the nickname, the "buoy farm". Pilots appear to perceptually organize the patterns made by the various combinations of markers as an aid in identifying their position in the channel. Several combinations of beacons and buoys are used by different pilots as ranges for steering, locating lateral position in the channel, and/or checking the positioning of other buoys. Buoy "hopping" on the red side of the channel is hazardous because of a shoal area that extends into the channel between the "54" and "56" buoys. For the lay person, at least, this must be the most confusing area in the port. From the R"46" buoy inbound, it is possible to see at one time at least 19 navigation marks and perhaps as many as 26. If the area is confusing in the daytime, it must be particularly so at night when ships are using the anchorage at Ward Point Bend and other traffic is moving in the various channels. There are no established ranges for the Ward Point Bend West Reach and turn. Pilots use smokestacks "cracked open" slightly, together and in combination, with various apartment houses for navigating the area.

4. Arthur Kill

Arthur Kill includes the nine reaches from the Outerbridge Reach to the North of Shooters Island Reach, located at the western entrance to Newark Bay. The advertised width is 500 feet and depths at mean low water are approximately 34 feet. Many of the ship movements in the area are high water jobs, i.e., timed to the extent practical to move on the rising tide and arrive at the dock just before the slack, high water.

The tugboats that will assist in the escort and docking operations wait in the vicinity of Perth Amboy, N.J. and Tottenville, Staten Island, for inbound ships. Likewise, they usually terminate their assistance duties at this point for outbounders.

Due to the close proximity of land throughout Arthur Kill, the pilot makes extensive use of the shoreline and the few established ranges for steering the vessel. Normally, he will maintain a track over the bottom as near the center of the channel as traffic conditions permit.

Speed control is an important navigation problem. The relatively narrow channels, the many docks and piers along which ships and barges are moored, and the presence of traffic makes it mandatory that large vessels proceed slowly. The pilot is always alert to losing navigation control at reduced speeds and must be ready to use the propulsion power in short bursts and/or tugboat forces to maintain his track line.

The tidal currents in certain reaches add significantly to the navigation control problems. The narrow channels and the relatively tight turns often cause the currents to ricochet off the shoreline and into the ship in a manner the uninitiated may not be prepared to expect. With the pilot's local knowledge and his experience in handling various size vessels in the area, he is prepared to anticipate these conditions and to position and otherwise maneuver the ship to counter and/or use these forces to his best advantage.

Helm and engine orders, and particularly the former, must be carefully monitored in all narrow channels. Inexperienced and/or non-English speaking helmsmen are prone to become confused and turn the wheel the wrong way, or to steer on a buoy or object on the shoreline and fail to take into account the current set.

Two fixed bridges and one lift bridge cross the Arthur Kill. Extra caution is required in approaching the lift bridge, particularly on a fair tide (which we have noted is standard conditions for large vessels), because of the always present uncertainty about when and if the bridge will be raised.

In the North of Shooters Island Reach the tidal currents flowing through the Arthur Kill, the Kill Van Kull and Newark Bay converge around the "17" and "18" buoys. Thus, a situation can exist where eastbound and westbound ships meeting each other can both be experiencing the same tide conditions, i.e., both can have a fair tide or both can be stemming the tide.

In this area, also, the aids to navigation change. Newark Bay is considered the port of call for placement of the aids to navigation in the Arthur Kill and the Kill Van Kull.

5. Kill Van Kull

The Kills extend from the Constable Hook Reach at St. George, Staten Island to the Elizabethport Reach, Arthur Kill. The ship channel is 600 feet wide and approximately 34 feet deep at mean low water. A large percentage of the ship traffic in the Kills is container ships going in and out of Port Elizabeth and Port Newark in the Newark Bay.

Essentially the same types of navigation problems exist in the Kills as in other parts of the Upper Bay and in the Arthur Kill, and pilots, in principle, use the same types of information in about the same way for solving them.

6. Newark Bay

For the purposes of this study, the Newark Bay extends from Bergen Point to Port Newark Terminal. The channel width is variable from about 900 feet just north of Bergen Point to 600 feet in the Newark Bay Middle Reach. The channel depth is about 30 feet at mean low water. The channels in Port Elizabeth and Port Newark are about 500 feet wide, with depths of 25 feet and 24 feet, respectively, at mean low water. The more recently constructed container berths, south of the Elizabeth Channel, have water depths at the dock of about 35 - 38 feet. These berths are used by the largest and deepest container ships calling on the port.

Two primary navigation problems stand out in this area: The Bergen Point turn and the passage through the Newark Bay Draw Railroad Bridge. The turn around Bergen Point is about 110°. Good control over the track of the vessel must be maintained at all times. On the larger and deeper ships, which usually have to proceed at speeds that provide for only marginal navigation control, the use of tug forces for assistance in making the turn is standard procedure.

For inbound ships the turn is further complicated by the need to be positioned, when the turn is completed, for immediate passage through the Bay Draw.

The rise of the land at Bergen Point and the several oil storage tanks located there effectively blocks visibility around the turn for ships inbound from the Kill Van Kull and outbound to the Kills. Pilots are therefore very much dependent on establishing VHF radio communications with traffic in the area to avoid awkward and dangerous passing situations.

The bridge usually presents the most problems during the downbound transit. Frequently, vessels must hold above the bridge for significant time periods waiting for a scheduled train to cross the bridge. Ships leaving Port Newark and Port Elizabeth can usually plan their advance to the bridge to provide a reasonable safety margin. However, the larger vessels using the south end of the Elizabeth Port Authority Marine Terminal have much less distance in which to "expand time". Once they have undocked, significant delays in raising the bridge become increasingly troublesome, particularly on the ebb tide. Still another factor of importance during the downbound transit is the wind conditions. The relatively unsheltered area of Newark Bay permits greater adverse wind effects on the vessels while positioning for and during passage through the bridge.

The pilot's local knowledge of the variable currents and wind effects are of primary importance in directing ship movements in this area. The ability to anticipate conditions and their probable effects accurately, appears to be a key factor in positioning a vessel for a particular series of maneuvers and in handling the general control problems confronting the pilot.

APPENDIX A

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APPENDIX A

NAME OF SHIP: Atlantic Cinderella

ROUTE OF TRANSIT: Ambrose Light, Atlantic Ocean to Port Elizabeth, N.J.

DATE: March 22, 1977

SHIP'S DATA:

Registry:	Sweden
Type:	Container Ship
Size:	DWT: 15,352; LENGTH: 696'; BEAM: 92'
Draft:	30'
Propulsion:	Steam Turbine
Screws:	Twin Screw; Bow Thruster

BOARDING: Boarded with the Sandy Hook Pilot

TUG ASSISTANCE: Elizabeth Moran - 4200 H.P.
Carol Moran - 1750 H.P.

Summary of Points of Interest:

1. Background

The Atlantic Cinderella was boarded by the Sandy Hook pilot and the observers in the vicinity of Ambrose Light about 1100 hours, March 22, 1977, as a north east storm advanced up the Atlantic coast. Visibility varied during the transit from less than one-half to one and one-half miles, due to heavy rain and fog. Winds from the north east were gusting 20-30 knots throughout the transit.

The transit route followed the Ambrose Channel, through the narrows to St. George, at which point one of the assisting tugs came alongside to board the docking pilot. The transit continued into the Kill Van Kull, around Bergen Point and through the Bay Draw Railroad Bridge into Newark Bay. And finally

Elizabeth Channel where the vessel was docked on the south side, port side to the dock. Due to technical problems with portions of the video recording tapes, some editing was required at Bergen Point and during the docking.

Two presentations are provided for this transit. The first is an edited version covering the highlights of the entire transit that can be viewed in approximately 20 minutes. The second covers the entire transit from the original tapes with the only editing being that required to remove from the presentation those sections where the video quality was unusable. This written account is prepared from the original tapes. Following the transit the pilot viewed the tapes and provided comments, and in some cases, additional information. In the text these are referred to as debriefing comments.

2. The Video/Audio Presentation

The presentation starts at the entrance buoys "1A" and "2A", to Ambrose Channel.[1] The pilot observes there is a slight sea and that it is worse here at the entrance buoys because the water shoals up.

(Water depths are decreasing from roughly 90' just to the west of Ambrose Light, to the high 40's and 50's at the "1A" buoy, to the high 30's immediately east of the entrance buoys and the high 20's at approximately the "2" and "3" buoys. Ambrose Channel is about 45' for it's entire length of 9.2 nautical miles.)[2]

The pilot notes the time and concludes he will go through two tide conditions during the transit. The transit starts on the end of the flood, will become slack water for a time and at Bergen Point the ship will be experiencing the ebb tide.

The pilot boat New York is visible, passing on the port side. The pilot calls the New York to check on the visibility conditions he experienced coming down the channel. He learns that the visibility will be less for a

[1]See Chart Appendix B, p. 2B
[2]See Chart Appendix B, p. 1B

short distance then should improve. The Atlantic Cinderella is blowing the fog whistle and moving up the channel on maneuvering speeds at about 14 knots.

(During the debriefing the pilot said that had there been more traffic, he would have reduced speed for these visibility conditions. In this case there was only one large vessel coming down the channel, the New Jersey Maru, and he was in radio contact. Thus, he felt comfortable proceeding at 14 or 15 knots. He added that in cases where a number of vessels are in the channel, pilots will usually regulate their speed to fit with that of the other vessels, with the slowest vessel setting the pace. This is particularly the case in visibility conditions such as those being experienced in this transit.

Also during the debriefing the pilot observed that normally he would have spent more time talking with the master, telling jokes, keeping him calm, since he felt he was rather "up-tight" because of the visibility and, what must have been to the master, very confined waters.

As the pilot watched the recording during the debriefing, he occasionally lost track of where he was, "4" buoy or "6" buoy. He said that during transit he mentally keeps track of each buoy and the time as he passes.)

The pilot observes that with the exception of the entrance buoys and the first nun buoys, the remainder through the "18" buoy, are spaced at one-half mile intervals. This is very helpful, he says, in making time and speed estimates in the channel. The consistency in the spacing of buoys also aids in using the general rule of thumb: One degree of course change equals 100 feet of lateral movement in one mile. This rule is helpful in adjusting position off the buoys.

The faint outline of the New Jersey Maru becomes visible just off the starboard bow. Her apparent position, crossing our bows, is due to the fact that she is in the second leg of the channel preparing to make her turn at the "10" buoy and we are also approaching the turn at the "10" buoy.[3] The master, not being aware of the turn, approaches the pilot somewhat excitedly, calling his attention to the outbound ship.

[3]See Chart Appendix B, p. 3B

(During debriefing he added that at this point he was aware that the ship was setting to the right hand side of the channel. He had corrected 2° to the left to try to identify how much correction would finally be required to counter the set. At the next buoy he added another 2° to the left.)

The New Jersey Maru passes, one whistle, while the Atlantic Cinderella is in the turn at the "10" buoy.

(At the debriefing, the pilot called attention to the difficulty in judging the turning rate of the vessel under these visibility conditions. Having given the rudder order and observed the indicator he can anticipate when the ship should start to swing, in 15 or 20 seconds. Many gyros have an audible "click" at each degree. The rate of clicking is a useful cue for judging rate of swing. Not all gyros, however, have an audible sound. Another primary cue is the "angle" of the sea. As the ship swings the "angle of attack" of the sea against the ship can be observed changing. The rate of change usually correlates well with the rate of swing.)

After making the turn at the "10" buoy the visibility drops to less than one-half mile and the pilot asks the master to put the radar on the three mile range and reduces speed to <u>half ahead on two engines</u>.

(During the course of the study we have never observed a pilot adjust a radar. Several have explained that they never do. They always leave it to the master or watch mate. Aside from courtesy considerations, there are so many different radars afloat, with so little standardization of control locations, that pilots find it more efficient to put it on the crew to adjust and peak the picture as needed.)

As he approaches the turn at the "14" buoy he explains that he expects to take advantage of the wind striking the "housework" (on the starboard quarter) to assist in making the turn. He orders <u>10° right rudder</u>. He observes that normally (under different wind conditions) at these slower speeds he would use more rudder to start the turn. As the turn progresses towards the heading of the final leg of Ambrose the wind brings the rain more directly in contact with the bridge windows and visibility becomes more restricted.

(The pilot has been working on and off the radar throughout the transit. At this point he moves his conning position to the port side of the bridge directly behind the radar.)

In the final leg of the channel the pilot is steering a few degrees to the right of the normal heading. He explains that he is doing this to compensate for the set of the ship to the left, primarily due to the winds, and to approach the Verrazano Bridge to the right of center, in case he should meet outbound traffic steering to the center of the bridge. He adds that he feels more "comfortable" in this position. (The recording tape runs out and is replaced.)

Observing the radar, the pilot sees a vessel outbound at the Verrazano Bridge. Without knowing the name of the ship he is nevertheless able to establish the radio contact by calling the "unit outbound at the Verrazano Bridge." The term unit refers to a Sandy Hook Pilot and his position allows the pilot on the other vessel to identify that he is being called. As radio traffic lessens temporarily, he responds. By consent the two pilots switch to channel 18 from 13 to permit conversation without adding to already high congestion on 13. The other pilot is seeking information about the visibility conditions he can expect outbound.

The pilot observes the "tankships" anchored in Gravesend Bay and explains what their position at anchor tells him: They are laying to the wind. This is due to the strong wind and the slackening tide. Because of the strong wind they will be very slow to turn with the ebb tide, resulting in their "tailing towards the channel" for some time. This will effectively narrow the channel until the force of the ebb brings them around.

During the next scene the pilot attempts repeatedly to establish radio contact with a towboat maneuvering a barge just below the Verrazano Bridge on the Brooklyn side of the channel.

(As the ship gets closer it becomes evident that the towboat is taking in his towing hawser in preparation for moving around behind the barge into a pushing position. This will allow better control of the barge in the more confined and heavier traffic areas of the upper bay. Another, smaller tug is laying off, apparently to provide assistance if necessary. The likely reason for not being able to establish radio contact is that the mate is controlling the towboat and the deck operations from the after deck steering position, located outside the wheelhouse, and is isolated from the radio.)

These attempts to establish radio contact with the towboat are interrupted by calls from the docking pilot regarding his boarding situation. He is advised that the side port is open for boarding on the port side of the ship. He locates his position as being above the bridge. An outbound vessel, the one spoken with earlier, port to port. The pilot explains that he did not blow two whistles to the towboat, indicating his intention of passing the towboat starboard to starboard, because of the other ship in the channel, it might confuse him, and because of his concern that the towboat might "panic". He also notes the danger in the situation: the wind is setting the barge across the channel, a failure on the towboat could cause loss of control of the barge.

(In all fairness to everyone, it could be observed that the pilot is correct, the towboat is engaged in a risky maneuver. However, in the absence of a defense from the tug master it might be tentatively considered that perhaps he could not perform the maneuver safely prior to approaching the Brooklyn Shore and the lee it provided. On the other hand the pilot could have contacted the outbound ship via the radio and informed him of his intentions to give the tug two whistles. Under these circumstances it is unlikely that the outbounder would have been confused. With respect to "panic" on the towboat, at hearing two whistles from a ship, this is regarded as unlikely in the observer's view.)

Immediately afterwards a vessel attempting to anchor in Bay Ridge[4] announces on channel 13 that he is dragging anchor and "rapidly leaving the anchorage backwards." The pilot establishes radio contact to learn where the troubled vessel is located. (Between the "26" and "28" buoys.) He observes that the

[4]See Chart Appendix B, p. 4B

ship is north of the Kills and should not directly affect us unless other downbound vessels are forced to maneuver in a manner that eventually impacts on our transit route.

The pilot talks about the Verrazano Bridge and it's possible effects on visibility between the upper and lower bays. He says it sometimes traps fog on one side or the other. Being aware of this, he is cautious of potential changes in visibility in the vicinity of the bridge.

As the Atlantic Cinderella passes Stapleton Anchorage the pilot says that he will be looking for possible anchorages so he can pass the information to a tankship he knows will be coming in from Ambrose later.

The vessel that earlier attempted to anchor in Bay Ridge is beginning to move from Bay Ridge to Stapleton Anchorage. The pilots tentatively arrange passing signals (one whistle is recommended by the other ship), but they wait to confirm the passing arrangement until both vessels have visual contact and are assured that a port to port passing is safe.

As the pilot observes an approaching tug he says that it "should be ours". He then slows the ship and observes that he is steering a course "quite a bit to the right of the channel course" due to the wind and it's greater force on the ship at lower speeds. He also observes his watch and says that he knows the Ferry schedules (Battery to Staten Island and return) and wants to time his crossing of their transit route to minimize encounters. Later he orders <u>dead slow port engine and half ahead starboard</u>.

(This permits more turning action without significantly increasing headway, the pilot explains during the debriefing. He also points out, as the Constable Hook range comes into view, an area just to the left of the range that he refers to as a "black hole". In approaching the range at night, with good visibility, this area has no visible background or shore lights. Thus, a ship passing the area with range and running lights on can be readily identified as traffic . Pilots seek out "black holes" in the harbor and make important use of them at night to help identify moving traffic.)

Once the docking master has had time to get aboard, the pilot orders half ahead on two engines, to provide more rudder power for the turn at St. George. He also illustrates how the "seams" between containers can be used as "sights" to the range, thereby aiding the steering task when the pilot is not standing on the centerline of the ship (conn position #1). He then asks the master to start the bow thruster. As the docking pilot arrives on the bridge the observer recognizes him from a previous transit.

(The recording tape is changed.)

(During the debriefing the pilot noted that the docking pilot did not relieve him as quickly as they often do. He felt that this was because the docking pilot was watching to see how the ship handled in the wind conditions that prevailed.

As the Sandy Hook pilot negotiates the turn into the Kills, his technique makes use of the twin screw characteristics of the vessel to assist in the turn. This is somewhat in contrast to the technique of the docking pilot who seems to rely more on the rudder power and less on the engines in maneuvering in tight waters.)

As the docking pilot takes over, the Sandy Hook pilot briefs him and advises the master that the docking pilot is ready to take the conn.

The docking pilot provides general comments and information about the ship, the channel and weather conditions. He is also faced with trying to hold the ship back as much as possible because the linemen for the dock are scheduled for 1300 hours. The ship is running about 15 minutes ahead of schedule at this point.

(A number of pilots commented during the study that all other factors constant, they prefer to be running late rather than early. Running late permits the pilot to make maximum safe speed which in turn usually provides optimum navigation control over the vessel. As he is forced to kill time, headway must be reduced to a minimum and consequently affords something less than optimum control over the vessel. One of the concerns the docking pilot has in this instance is the effect the wind will have at the dock. If it is too great, he will not likely be able to hold position off the dock until 1300 hours.)

As the pilot orders 10° starboard rudder and the ship does not respond, he laughs and says, "I thought the wind had diminished in here, but I guess not," and orders starboard 20°. Only then does she slowly start to respond. He then alerts the tugboat Elizabeth to standby on the starboard quarter for assistance as needed.

A discussion about his intended use of tugs around Bergen Point and through the Bay Draw establishes that the tugs will not have lines up, but will be alongside around the point in case they are needed.[5] Since the ship could set either way, the pilot indicates that they will only follow through the draw. The discussion continues with both pilots talking about the ship handling techniques for this area of the harbor.

(The Bergen Point turn is not presented due to technical difficulties with the recording tape.) As the presentation continues, a portion of the turn has been completed and the railroad bridge is coming into view forward. The Sandy Hook pilot is providing a descriptive explanation of the maneuver. Shortly afterward, the docking pilot picks up the explanation. The buoys on the starboard hand mark a solid rock point covered with just a few feet of water.

As the ship moves through the bridge, the pilot says that the can buoy and beacon ahead mark a shoal area. As soon as he is clear of the bridge he must come right to stay in the channel. He observes that the outbound transit is the hardest since the open area of Newark Bay permits greater wind

[5]See Chart Appendix B, p. 11B

effects on the ship. When there are strong winds the headway must generally be greater to maintain navigation control. Once through the bridge the headway must then be reduced rapidly in order to make the Bergen Point turn.

After passing through the bridge, the pilot orders slow on both engines and observes that he, "has to kill time", he is now about one-half hour early. He also says that by looking at the wind and waves it appears that the wind will be more on the pier rather than off the pier, as he figured.

As the camera pans into Port Elizabeth the general position of the berth can be seen directly beyond the ship docked on the left hand. Both vessels have stern ramps for unloading cargo and the dock has a concrete pier that extends perpendicular to the dock. Docking stern to stern permits both ships to use their stern ramps.

(Some editing of the presentation was required due to technical problems with the recording tape.) As the presentation continues the ship is approaching the dock and the pilot and observer are on the wing of the bridge in a driving rain. The pilot is trying to get a line up from the tug on the starboard quarter.

(Of greatest interest during the docking is the obvious problems the pilot had in communicating with the master and the watchmate. On two different occasions he was required to repeat orders several times. The first involved stopping the right engine and the second his order to use the bow thruster to assist in easing the landing on the dock. In both cases the wind and rain was probably a contributing factor in the communications failure. The language differences between the ship's personnel and the pilot no doubt also contributed to the problem.)

As the first lines hit the dock the presentation is concluded.

END OF TRANSIT

NAME OF SHIP: SS Fortaleza

ROUTE OF TRANSIT: Ambrose Channel to Port Elizabeth, N.J.

DATE: April 28, 1977

SHIP'S DATA:

Registry	U.S.A.
Type:	Ro-Ro-Container Ship
Size:	DWT: 15,136; LENGTH: 700'; BEAM: 92'
Draft:	24' 6"
Propulsion:	32,000 H.P. Steam Turbine
Screws:	One

BOARDING: Boarded with the Docking Master/Sandy Hook Pilot

TUG ASSISTANCE: Christine Moran - 1200 H.P.
Claire Moran - 1600 H.P.

Summary of Points of Interest:

1. Background

This is one of two transits made on the Fortaleza reported on in this study. The ship runs between Puerto Rico and New York on a weekly schedule. In 1977 the ship, under the command of Captain J. R. O'Connor, won the Ship Safety Achievement Award presented annually by the Marine Section of the National Safety Council and the American Institute of Merchant Shipping for saving four lives on the sailing yacht Mystere, 130 miles off Cape Hatteras, North Carolina in a heavy storm.

The transit is unique on several counts. The video taping starts in the early morning hours just prior to daybreak. In the early scenes the visibility is restricted by the darkness. Lights from the Verrazano Bridge and the

Brooklyn shore provide some references for locating the ship's position in the lower bay. Some appreciation can be felt for the problems of overtaking and passing slower vessels in this area of the harbor as you listen to the pilot attempting to arrange a passing agreement with another large containership. Failing to arrive at a passing agreement results in having to follow the other ship into the upper bay, through the Kill Van Kull, around Bergen Point and through the Newark Bay Draw. With favorable winds and currents, the pilot is able to follow close enough to provide a clear view of the other ships "track" throughout the transit, which the Fortaleza closely duplicates. Some of the assisting tugboat operations for the other ship can also be observed. The Fortaleza is docked starboard side to the last berth on the south side of Port Elizabeth. Since the ship is too long to turn around in the channel, she is backed, with the assistance of two tugs, the entire length of the channel to her berth.

2. The Video/Audio Presentation

The presentation starts in the lower bay, south of the Verrazano Bridge.[6] Daylight is just beginning to break through and the lights of the Verrazano Bridge are becoming visible in the background of the picture. The master of the Fortaleza is discussing his weekly trips to the port and the general capabilities and services provided by the ship.

The pilot observes a small vessel to starboard and an inbound ship ahead. He is closing on both and he and the master speak briefly of the potential passing situations. The pilot orders the engine <u>half ahead</u> from full ahead. The master <u>stops</u> the pilot's order, saying he must order the engineroom to maneuvering speed before making any speed reductions, which requires about 10 minutes notice.

[6]See Chart Appendix B, p. 3B.

(Activities required in the engineroom to shift from the normal mode of operation, or "sea speed", to the maneuvering mode of operation, or "maneuvering speed", can vary widely depending on the design of the propulsion plant and the operating policies established for the ship. For large oceangoing vessels the emphasis for propulsion design is always on efficiency of operations during the normal mode of operation at the sacrifice, as necessary, of the maneuvering mode of operation. Older steam turbine plants included little automation of control. In such plants the change over between operating modes is especially critical to avoid "unbalancing" the plant, and somewhat time consuming. Furthermore, the overall power output of the plant during the maneuvering mode of operation is appreciably reduced. All of these consequences occur because propulsion capability in a non-automated plant is controlled directly by the number of steam nozzles being used, and in turn, the number of nozzles being used directly influences the operation of the boilers, the burner tips being used, and so on. On the other hand, automated steam turbine systems use an entirely different type of "throttle control" system which provides for more flexibility in their operation. Change over time can be negligible and the total power output of the plant need not be affected by the change from the normal mode to the maneuvering mode of operation, although it is ordinarily limited below the normal mode as a matter of shipboard policy.)

The pilot is asked what he is thinking about. He replies that he wants to get around the ship ahead of him (Tohbei Maru) and get on up to the Kills. At this point the Fortaleza passes under the Verrazano Bridge into the upper bay.[7]

The pilot calls the Tohbei Maru to arrange a passing. He confirms with the master that they might as well go on around. The return response from the Tohbei Maru is negative, "I think you ought to stay back there." The pilot apparently not believing what he is hearing, requests the Tohbei Maru to "say again, you came through all broken up." Before he receives an answer he orders the engine slow ahead.

(The master has been notified by the engineroom personnel that they are now in the maneuvering speed mode of operation.)

The Tohbei Maru finally responds by asking where the Fortaleza's tug boats are and where he is to pick them up. The pilot has not contacted his boats yet and

[7]See Chart Appendix B, p. 4B.

answers accordingly. He then orders dead slow ahead. The master then suggests that they try to find the Christine Moran, one of the tugs that will assist. The pilot says, "She (Maru) is not going to let us go by." The Maru's pilot calls back and says that he does not think it is a good idea for the Fortaleza to pass. The pilot then asks if he is going to start moving now and orders, stop the engine and tells the helmsman to let me know if you lose steerage. (It is not clear to anyone on the Fortaleza exactly why the pilot of the Tohbei Maru will not agree to a passing.)

At this point contact is made with the Christine Moran and arrangements for boarding the docking pilot are completed.

The Maru has been nearly dead in the water and now judging from the quick-water behind her the pilot says, "She is beginning to move."

The Christine later announces, via Channel 13, that the docking master is now aboard the Fortaleza. As the video begins to break-up, indicating the end of the original tape, the pilot and master explain that as the burdened vessel (in accordance with the Rules of the Road) if they choose to pass, in the absence of an agreement with the Maru, and an accident happened they "wouldn't have a leg to stand on in the courts." The docking master makes his appearance on the bridge. The Maru can be seen crossing the Fortaleza's bow.

As the new tape starts, the docking pilot relieves the Sandy Hook pilot of the conn. The docking pilot says it is starting to ebb in the Kills now. He makes a security call establishing his position off Bay Street, Staten Island, approaching the Constable Hook Range.

The observer engages in a variety of conversations with the docking pilot to provide him information about his presence on the bridge and to establish rapport. The Constable Hook Range comes into view (quick flashing light below a second light flashing at 6" intervals) dead ahead.

In discussing how the pilot familiarizes himself with a new ship, the pilot observes that on some ships a briefing sheet with relevant ship characteristics information is provided upon boarding, with the pilot sometimes being asked to read and sign the information sheet. During the conversation he illustrates the importance of making certain the pilot is aware of any unusual characteristics of the vessel by telling a "sea story" about a foreign flag tanker that has a left hand turning screw: Although the tanker had called on the port before, he had not been on it and his first time was at night. He says he was on the bridge wing most of the time and everything went fine. After the ship berthed they turned on the lights in the wheelhouse and there on the bulkhead was a placard announcing the left turning screw. He says, certainly that is one thing the pilot should know and would not normally ask about, since 90% of the ships have right hand turning screws.

(The side forces from the screw significantly influence the backing characteristics of ships. The side forces from a right hand turning screw push the stern to port when going astern; a left hand turning screw creates side forces that push the stern to starboard.)

The transit through the Kills is interesting in that the Fortaleza is following the Maru at a distance that allows one to anticipate the track of the Fortaleza by observing the track of the Maru.[8]

From the time the ship entered the Kill Van Kull the ebb tide has been flowing. As the Fortaleza approaches passage under the Bayonne Bridge the pilot notes that if the tide was flooding, putting it fair behind him, he would not be as close to the Maru as he is. He says that if he had to stop (causing a loss of steerageway) the current would set him into the rocks to

[8] See Chart Appendix B, p. 11B.

starboard; consequently, he would be laying much farther back of the Maru than he is now. At this point the Maru can be seen making the turn at Bergen Point. A tug on the starboard quarter of the Maru can be seen assisting her with the turn.

A discussion of visibility from the navigation bridge of various vessels is underway between pilot, master and observer as the Fortaleza is positioned for the Bergen Point turn. The camera pans the area several times, showing Shooters Island (ahead), the Bergen Point turn and the Newark Bay Draw Railroad Bridge through which the ships must pass.

As the Tohbei Maru passes through the Bay Draw, the three assisting tugs can be seen clearly and the pilots' orders to the Elizabeth Moran, on it's port bow, to back easy can be heard via the radio. The tugs on the starboard side are following along with the ship to assist if necessary. She bears off to the left as she passes through the bridge to a berth on that side of the bay. The Fortaleza releases her tugs for bridge passage, to pick them up again on the other side.

As the Fortaleza clears the Bridge the master says, "What a way to start your day, coming through the Bay Draw dead slow." He continues by observing that you have to have perfect conditions to do what the pilot just did. Had there been any wind, or the tide had been different, he probably would not have been able to navigate the bridge at dead slow ahead.

(A review of the video tape before and during passage through the bridge helps in understanding the master's comments. Several minutes before the bridge, the pilot reduced speed from slow ahead to dead slow ahead and finally was forced to stop the engine as the Maru continued her passage through the opening at, probably, dead slow ahead. Since the effectiveness of the rudder, or rudder power, is importantly affected by the total flow of water moving past the rudder, which results from the ship's movement through the water and the screw current passing by the rudder, the natural consequence of his engine orders is to reduce rudder power and consequently steerageway. The tape, of course, reveals an increase in the frequency and magnitude of rudder orders needed to hold the ship's heading. As the Maru passes far enough through the opening to permit the pilot of the Fortaleza to commit her to passage, he immediately orders half ahead. Since the rudder is directly astern of the screw, the screw current is the dominant factor in the rudder power equation. As the half ahead order takes effect, the rudder power increases as the square of the velocity of the flow passing the rudder. Thus, each time the flow doubles in volume, the force obtained from a given rudder angle quadruples. The master is, of course, correct in saying that the ship moved through the opening at dead slow ahead. However, with the screw current resulting from half ahead on the engine, the pilot quickly regained good rudder effectiveness despite the lack of significant effects from the ship movement currents. The observation that the pilot could not have successfully performed this maneuver if tide and wind forces had been different, is equally true. But as the pilot observed, much earlier in the transit, had conditions been less favorable, then he would not have been following the Maru as closely as he was.)

The pilot issues the tug's position orders in anticipation of backing the ship up the Elizabeth Channel to it's berth.[9] The Claire is positioned on the starboard quarter with the Christine all the way up on the port bow. Since the pilot on the Maru, who is now in the docking process, and the Fortaleza pilot are both from Moran Towing and Transportation Company, Inc. and both are speaking to their tugs on the company's radio channel 7A, the Maru's pilot can be heard in the background giving orders to the assisting tugs.

The pilot is asked what he is using as a reference to judge where he will make his turn for backing into the channel. He says he "doesn't use anything for a reference," he is only watching his speed through the water and how the ship is handling.

(The pilot probably did not fully understand the question, it seems apparent that the centerline of the Elizabeth Channel is an important reference here.)

[9] See Chart Appendix B, p. 11B.

As the pilot starts to position for the turn he orders hard left rudder and half astern on the engine, then midship the rudder. As the ship starts backing, headway is being reduced and the bows start swinging to the right as the ship backs to port. He then moves to the port wing of the bridge. As the camera is moved to the bridge wing the pilot can be observed facing the Port Elizabeth Channel directly abeam of the ship. The Christine can be seen working half ahead on the port bow. The Claire is working half ahead on the starboard quarter. The pilot says, "A big part of this work is to give the (tug) boats a chance to work." He then orders hard right and slow ahead. A few seconds later he orders stop engine. The Christine has had difficulty with it's line up to the ship because of an existing line on the chock. Conversation has been going back and forth: master, crew, pilot and tugboat mate regarding the problem. The pilot then moves to the starboard bridge wing.

Before leaving the port wing he tells Roy (Christine) to work easy and let him know when he gets his line off the ship, and orders the ships' rudder midships. The Christine reports the line off and asks if she should work the starboard bow? The pilot says yes.

As the stern begins to line up to the channel, the Claire is ordered all stopped and around to the other side (starboard). Christine is ordered one whistle (half ahead) on the starboard bow. As the stern swing is checked, the Christine is ordered stopped and a few seconds later one whistle and then all stopped. The fore and aft axis of the ship is now generally in line with the center of the channel.

The Claire is asked if she will use a line on the ship (off the stern), or on a panama canal chock on the port quarter? She responds, the port quarter.

(A panama canal chock is built flush into the hull of the ship at a height from the waterline that can be reached by the tugboat crew directly. The Claire elects to use the panama chock, probably because this position will permit her to assist the ship up to the channel, without the need to reposition herself as she is needed to push the ship to the dock. The power to move the ship up the channel comes from the ship's engine, while directional heading is largely supplied by the tug on the bows. The tug on the port quarter can be used to cancel the tendency of the ship to back to port, assist with directional control and provide some sternway if necessary. Of course, with the ship backing, rudder power is for all practical purposes nil. The slow sternway provides little ship movement current pass the rudder and the screws' suction current provides for only nominal rudder forces.)

The pilot explains that the tug on the bow is being used as a rudder. If it were a windy day, he says, the after tug would put a hawser up to the stern and tow the ship, this would provide for needed extra control over the stern. The pilot says that he is watching the stern to see if it is turning one way, or the other and directing the tugs accordingly.

While the tape was being replaced the pilot strongly makes the point that in these jobs it is important that the tugs you are working with are experienced and have worked with you previously. They can better anticipate your needs and respond more quickly to your orders.

As the ship continues backing towards it's berth, the pilot of the Tohbei Maru can be overheard giving his tugs (Elizabeth, Marie, Diane) orders. A container ship with ongoing cargo operations can be seen off the starboard side of the Fortaleza. Approaching the berth at the far south side of the channel, the cargo ramps for the roll-on, roll-off operations can be seen. Newark Airport is in the background.

The pilot angles the stern towards the berth as soon as it is clear of the ship docked at the container berth. He continues to control the direction of the stern by using the tug on a bow as a rudder. As the berth is approached the sternway is being controlled by the ship's engine. As the docked containership is completely cleared, both tugs are working to push the ship into a position parallel with the dock.

A ship following up the channel executes a 180^{o} turn to dock port side to a berth on the north side of the channel. It is a much smaller ship than the Fortaleza and can be turned in the channel with relative ease.

The pilot gradually works the ship to a position parallel with the dock and in a fore and aft position that approximately lines up the loading ramps on the dock with the cargo openings in the hull of the ship. The tugs then push the ship to the dock, where spring lines are put out to the line handling crews. The pilot notes that the overhang on the ship is such that great caution is required in landing the vessel to avoid touching the cargo ramp. Once the ship is landed, the tugs work to keep her to the dock and the ship's engine is used to line her up fore and aft. When in final position, the ship is held by the tugs until all lines are made fast.

END OF TRANSIT

NAME OF SHIP: Atlantic Span

ROUTE OF TRANSIT: Port Elizabeth to Ambrose Light, Atlantic Ocean

DATE: May 3, 1977

SHIP'S DATA:

Registry:	Sweden
Type:	Container Ship
Size:	DWT: 16,370; LENGTH: 646'; BEAM: 87'
Draft:	F 16'; A 26'
Propulsion:	Diesel, Bow Thruster
Screws:	One

BOARDING: Boarded with the Docking Master/Sandy Hook Pilot

TUG ASSISTANCE: Elizabeth Moran - 4200 H.P.
Cynthia Moran - 1750 H.P.

Summary of Points of Interest:

1. Background

The observers boarded the Atlantic Span at her berth in Port Elizabeth with the docking master and the Sandy Hook pilot. The ship was berthed port side to the second dock in, on the south side of the terminal. The docking pilot moved the ship off the dock and backed into Newark Bay Middle Reach and made a 90° turn to port to position for the Bay Draw.[10] There was a delay of approximately six minutes, with the pilot holding on the last of the ebb tide before the Newark Bay Draw Bridge was raised. Due to maintenance problems the west draw (horizontal clearance, 216') was not in operation and traffic was being routed through the east draw (horizontal clearance 134'). The transit route was through the east draw, east in the Kill Van Kull to

[10] See Chart Appendix B, p. 11B.

St. George, where the docking pilot turned the conn over to the Sandy Hook pilot, then to Ambrose Light in the Atlantic Ocean.[11]

Due to defective recording tape, the last few minutes of the approach and passage through the Bay Draw could not be included in the presentation. The presentation was concluded about 10 minutes prior to reaching Ambrose to permit the stowing of the recording equipment in preparation for leaving the ship.

2. The Video/Audio Presentation

The presentation starts as all lines are cast off and the docking pilot proceeds to undock the vessel. A 4200 H.P. tug, the Elizabeth Moran, is positioned on the stern with a line up to the main deck and the smaller tug, the Cynthia Moran, has a line up on the bow. The Elizabeth pulls the stern from the dock into the channel while the Cynthia controls the bows. As the ship is aligned with the channel, the ship's engine is ordered slow astern and the vessel is backed out into Newark Bay Middle Reach. The Elizabeth assists in establishing and maintaining the sternway while the Cynthia assists in keeping the ship backing straight out of the channel.

As the stern approaches the Newark Bay Channel the pilot begins to turn the vessel. He orders rudder hard to port; orders the Cynthia to take her line down and move farther forward on the starboard bow and when she is in position he orders the Cynthia hooked up (full ahead); the ship's engine is ordered dead slow ahead and then slow ahead. These actions stop the sternway and start the bows swinging to port to line up with the channel.

As the ship's head lines up with the Bay Draw the pilot is advised that the east draw (left) will open in six minutes. The Cynthia is ordered

[11] See Charts Appendix B, pp. 4B, 3B, 2B, 1B.

to the port bow, no line up.

The pilot notes the ebb tide, but says, "It is not bad. It is not setting us sideways." As the ship holds in position waiting for the Bay Draw the pilot is using hard port rudder and the engine is on stop. As the draw bridge starts up he orders dead slow ahead on the engine and eases the rudder to port 10° and then midship and steady. Some concern develops as a tug and barge approach the draw, from the other side, as though it may be preparing to go through. Both the pilot and his mate on the Cynthia try to establish radio contact, with no response. As the aspect of the tug and barge start to change to it's starboard hand it becomes clear that it is not coming through the draw.

The pilot advises the master and then the Cynthia that she will put a line up on the port bow, on the other side of the drawbridge.

(Due to poor video quality, resulting from a defective tape, the final approach and passage through the east draw had to be edited from the presentation. The presentation continues just after the ship passes through the draw, approaching Bergen Point.)

The pilot refers to the visibility problems on clear nights, "everything blends together," and notes it is, "much easier on hazy nights".

(A critical task for the pilot is to observe for risk of collision with other vessels. Such risks must be detected and evaluated in time to take necessary, evasive action. In New York, fresh northwest winds tend to clear the atmosphere of pollutants. As the atmosphere clears, lights at varying distances that are normally not a part of the night visual scene become observable, cues for distance judgments change and vessel running lights that are close in to shore, blend with the "enriched" visual patterning of the shoreline. Thus what may appear to the casual observer to be ideal night time visibility conditions, in fact, often present added vigilance problems for the pilot.)

As Bergen Point is approached, the pilot notes that the rocks are visible and says you must know when to start the turn. The Elizabeth is now positioned on the port quarter and the Cynthia on the port bow. Both have lines up to the ship. He orders hard port rudder; Elizabeth slow ahead; Cynthia half astern; Elizabeth one bell (half ahead); slow ahead on ship's engine. Later he eases to port 10^{o}. As the turn is almost completed he stops the Cynthia and releases the Elizabeth from further assistance.

Calling attention to the rocks off the port beam the pilot speaks of a grounding he experienced last winter under the Bayonne Bridge. A cotter pin in the throttle system broke and the power plant went down. As he passes under the Bayonne Bridge, he advises the Cynthia to take her line down and position to take him off the ship on the port side.

The passage through the Kills is uneventful. The pilot notes the Hess Bayonne pier and observes that the pier has no place for headlines and sternlines. He generally disapproves. A little later the camera pans the pier. Still later the camera picks up the small vessel the Sandy Hook pilot spoke of earlier tied up to the Banks Street Dock.

(This is a rarely used berth. Most currently working Sandy Hook pilots have never had an assignment to it and do not know it by name.)

As the ship approaches the Constable Hook Range at St. George, the Sandy Hook pilot relieves the docking pilot and the latter leaves the ship.

The pilot notes that some of the interference being heard on the radio is from the police network antenna located nearby. He says that interference frequently occurs in this area.

As the pilot responds to a request to think out loud, the Constable Hook Range lights can be seen off the port beam. As the observer walks away to speak to the master, the pilot stops talking. The observer returns and the pilot once again speaks of the area and the problems it presents along with his intentions for maneuvering through the area. He notes that we will carry the last of the ebb tide, probably to the "10" buoy in Ambrose Channel, where we might even pick up the flood tide before we leave the channel. He says, "We tried to catch the minimum amount of current coming through the Bay Draw and in doing so we ran into flood current in the last part of the Kills until we cleared the ferries here, so we had ebb tide, flood tide and now we are back to ebb tide and before we get out to sea, we will have flood tide again." When asked to explain how that could be, he says, "You have different stages of tide in different sections of the harbor. And actually the Kills is not a river, we are running into river current here (Hudson River). The Kill Van Kull is a sound, it connects two larger bodies of water. You get different current in a sound than in a river...It's a science to learn everything about the tides in this harbor because we have so many different river currents adding to the various straits that we have. And mostly in these straits is a hydraulic current where it starts moving at exactly the same speed no matter where you are in that strait, whereas the river current will build up against the tide coming in from sea, or run out with the tide."

(The pilot has 35 years of experience in New York Harbor. His brief discussion of the complexity of the currents in the harbor clearly establishes another facet of local knowledge important to safe traffic movements. It should be noted, also, in conjunction with his comments, that the East River is really not a river, it connects Long Island Sound with the upper bay.)

Approaching the Verrazano Bridge, the pilot calls Maritime Exchange and provides information regarding the vessel's next port of call. The Exchange advises him that the pilot boat is anchored off Ambrose and the launch will take him off on the port side of the ship.

(The Maritime Exchange is operated by the maritime industry in New York. It provides a variety of services to the industry including the logging of ship movements in and out of the harbor.)

As Stapleton anchorage (to the starboard hand) is cleared, the pilot orders full ahead and advises the master he can increase speed if he wishes.

(Here he is probably advising the master that he can go up to a sea speed, from maneuvering speed, if it is appropriate to do so.)

The transit to Ambrose Light is uneventful. The pilot provides general information of interest about the area.

END OF TRANSIT

NAME OF SHIP: S. S. Sealand Galloway

ROUTE OF TRANSIT: Elizabeth Port Authority Marine Terminal to St. George, Staten Island, N.Y.

DATE: April 27, 1977

SHIP'S DATA:

Registry:	United States
Type:	Container Ship
Size:	DWT: 27,141 ; LENGTH: 998' ; BEAM: 105'
Draft:	34'
Propulsion:	Steam Turbines
Screws:	Two

BOARDING: Boarded with the Docking Masters.

TUG ASSISTANCE: Grace McAllister - 3200 H.P. Flanking Rudder (Kort Nozzel)
Jane McAllister - 3200 H.P. Flanking Rudder (Kort Nozzel)
Brian McAllister - 2400 H.P. Flanking Rudder (Kort Nozzel)
Margaret McAllister - 1800 H.P.

Summary of Points of Interest:

1. Background

The Sealand Galloway is an SL-7 class ship, the largest ship calling on the port. One pilot is used to bring the vessel from the seabuoy to St. George in the upper bay and return. Normally four tugs and three docking pilots are used for the transit through the Kills to and from Port Elizabeth. One docking pilot is designated to handle the conn and the others provide needed assistance. The docking master and one other senior pilot operate on top of the afterhouse located around the stacks. The third pilot is stationed in the bridgehouse located near the bows of the ship. The latter's function is to relay conning orders to the bridge crew. Locating the conn on the afterhouse is made necessary because the afterhouse blocks the view of about 360' of the stern from even the outermost part of the bridge wings. The two pilots you will see on the afterhouse are regularly assigned to SL-7 movements and take turns in handling the conn.

The Galloway was berthed at the southern end of the Elizabeth Port Terminal Authority's container terminals, port side to the dock. Another vessel was berthed immediately behind her. As she is undocked, she is pulled off by the four assisting tugs and maneuvered to a position permitting a starboard turn out into the Newark Bay South Reach, immediately north of the Newark Bay Draw Railroad Bridge.[12] As the presentation starts, the Grace is located on the port bow, the Brian on the starboard bow, the Jane on the stern, and the Margaret on the port quarter. The ship has just been advised that the Bay Draw will not be raised for an estimated 10 minutes. Thus, the pilot must concern himself with holding the ship on an ebb tide, immediately above the bridge, until a two car train passed.

2. The Video/Audio Presentation

In the first scene the Galloway is off the dock and the pilot has explained that the objective now is to back down and off the dock far enough so that when he makes his turn to starboard (180°) he will be well clear of the ship docked off the port quarter and be in position to proceed through the Bay Draw Railroad Bridge. The senior assistant pilot has talked with the draw operator and has been advised that there will be a 10 minute delay before the bridge can be

[12]See Chart Appendix B, p. 11B.

opened. He slows his rate of turn to delay the approach.

As the pilot positions for the bridge, he orders the starboard side tugs half ahead saying, "I want to get over another width (of the ship) here, because the ebb tide will set me to the right and the wind will be setting on that side, so I want to lift her bodily over this way." The pilot explains that positioning for the bridge is determined by where the pilot feels comfortable and that it's rarely ever the same way twice.

(It is interesting to note the composed calm exhibited by both pilots while they wait on the ebb tide for the train. The viewer will realize that this is a tension producing situation. With the tide moving the ship ever closer to the bridge, a few more minutes delay could have easily resulted in a requirement to back engines, which could have resulted in a loss of positive control over the ship's position. With today's public attitudes and the many official expressions of concern being shown for marine transportation safety, one must be inclined to fully agree with the senior assistant pilot's statements of disbelief over the circumstances being viewed.)

After the train passes over the bridge, the draw is raised for the ship.

The pilot orders slow ahead on two engines and rudder hard port to assist the tugs in lifting the ship over to port.

All tugs except the Jane on the stern are ordered clear of the ship.

(The bridge opening is 216' and ship's beam is 105'. The second pilot is on the starboard side of the afterhouse advising on the clearance. All tugs except the Jane are clear of the ship. She is on the stern assisting the rudder actions.)

As the ship enters the bridge opening the pilot orders right 20° rudder to lift the stern over and stop the starboard engine. (As will be explained later, the Jane also responds to the rudder order.)

After clearing the bridge, he orders the port engine stopped. Both engines are now stopped to reduce the headway in anticipation of the Bergen Point turn. The tugs reassume positions with lines up to the main deck. The

Jane is still on the stern with the pilot explaining that she is his additional 120° rudder. He observes that twin screw ships with a single rudder do not steer as well as single screw, single rudder, or twin screw with twin rudders.

He orders the Jane half ahead, says he is going to use her on the port quarter to provide a little more swing to the bow than he could get from the rudder alone. As the ship starts to swing, he orders dead slow ahead starboard engine and hard left rudder, and announces he is starting his turn. He then orders Jane full ahead on the port quarter. The pilot observes that with a ship this size it is critical that the turn be started right, since adjustments later are difficult to make. He orders the Jane half ahead and later easy ahead as he judges the bow is swinging too fast, saying if she continued pushing full ahead the ship would be on top of those beacons to port. He also orders dead slow ahead port engine, saying that he wants to increase his headway to get beyond the beacons and still maintain the swing. As the job is done repeatedly, he says, we all develop our own track for the way we like the job done, "we try to be like a railroad, you know you have been safely here and safely there, you know where the trouble lies, where the water is, all through the course of experience; you have seen other misfortunes." He then orders Jane full ahead to increase his rate of turn. He is beginning to stand clear of the rocks to his port side and can come "right up to the nun buoy" on the port side if he needs to do so. He now notes the green light in the middle of the bridge, marking mid channel, and is steering to go directly under the light. He orders Jane slow and back away on the Margaret, to check the swing to port and bring the Galloway to the center of the channel.

In the background the other assisting pilot can be heard making the Bayonne Bridge security call. The pilot explains that the assisting pilot monitors channel 13 while he stays on the company channel to communicate with the tugs with minimum interference.

The pilot now indicates that he has successfully completed the turn, has stopped the assisting tugs (except the Jane) and will now give rudder commands. He says that he will stay in the middle of the channel as much as possible due to the length of the ship.

At this point the pilot moves to the forward end of the deckhouse located between the stacks. The camera is left on during the move.

As the pilot's comments continue, he explains that all the tugs still have lines up, but only the Jane, on the stern, is working. As he gives rudder commands, the tug moves to the appropriate quarter and pushes in concert with the command. These maneuvers by the stern tug are standing operating procedures and are done without individual orders to the tug.

As the ship proceeds through the Kills, the pilot explains that he judges her position in the channel by noting the amount of water on either side of the ship's navigating bridge wings. (The bridge wings also serve to locate the bows, which cannot be seen.) When in the center of the channel, he has about an equal amount of water between the bridge wing and the shoreline on either side of the ship. At this point he says he is just a little right of center and orders a left 10° rudder.

(The Jane, hearing the order, will move to the port quarter and push ahead easy to assist in turning the ship.)

The pilot explains that the communication sequence for ship commands goes from conning pilot to assistant pilot on the bridge, who acknowledges receiving and understanding of the command by repeating the order back to the conning pilot. The assistant pilot then gives the order to the helmsman, or watchmate, in the case of engine orders, who in turn repeats the order back to the assistant pilot. And, of course, the assistant pilot monitors the helm and engine orders to insure they are carried out correctly.

The pilot speaks of the wind, very little easterly, and of traffic and the problems it can cause a ship of this size. He notes that farther out, there is a "critical S turn where you don't want to meet any traffic."[13]

(Although expressions of caution and concern are characteristic of pilots moving large ships through the Kills, this is the only time we heard the Constable Hook Reach referred to as a "critical" area, "where you don't want to meet any traffic". To the observer this was a very significant comment, emphasizing the operationally complex relationships that exist between a given waterway, the size of the transiting vessels and the accompanying restrictions placed on the maneuverability of the vessels as their relative sizes increase. In part, at least, the pilot seems to be saying that due to the size of the SL-7 he does not want to meet another vessel in the Constable Hook Reach because he can do little or nothing to assist the passing. In a passing situation, the onus, then, for safely maneuvering around him must lie with the other vessel. If she in turn has significant maneuvering restrictions placed on her due to size, the probability of a mishap increases rapidly.)

The pilot tries to recall how long SL-7's have been coming into New York. He thinks about 5 years and is certain that the Galloway was the first one. He says they now come in, round trip, one a week.

Ordering <u>left 10°</u> rudder, he says, "now I want to come on my own personal track, I enjoy following in and out. You think about your bow sweep and your stern sweep."

Observing the point of land at Port Richmond he says, "we all avoid this little knuckle here on the right, deeply laden ships have been known to bounce and touch bottom here. And there are times when you are close and very concerned about it...that's why we have this two foot critical area...as I told you before, Sealand wants 2' of water under the ship as we traverse the Kills."

The pilot speaks briefly of the process by which other pilots are

[13]See Charts Appendix B, pp. 11B and 4B.

brought along to handle Sealand's SL-7's. The original tape comes to the end as the pilot points out the landmark he is using as a steering aid (grey shed on top of a building).

As the Galloway approaches St. George, the pilot speaks of the procedure for transferring the conn to the Sandy Hook Pilot: He will position the ship outbound in the upper bay on the Constable Hook Range; when the Sandy Hook pilot feels it is positioned properly, he advises the assistant pilot on the bridge that he will take the conn and the transfer takes place. One large tug is assigned to escort the Galloway past Stapleton Anchorage to the Verrazano Bridge. This latter escort procedure apparently was put into use after the Esso-Brussels, Seawitch accident.

The pilot observes that there is not much current effect. He notes that in the new and full moon phases you have "twice the current effects as in the other two quarters."

Visibility due to darkness drops below the sensitivity level of the camera and the presentation is concluded.

END OF TRANSIT

NAME OF SHIP: SS Fortaleza

ROUTE OF TRANSIT: Port Elizabeth to St. George, Staten Island, N.Y.

DATE: April 29, 1977

SHIP'S DATA:

Registry:	U.S.A.
Type:	Ro-Ro-Container Ship
Size:	DWT: 15,136; LENGTH: 700'; BEAM: 92'
Draft:	28'
Propulsion:	32,000 H.P. Steam Turbine
Screws:	One

BOARDING: Boarded with the Docking Master/Sandy Hook Pilot

TUG ASSISTANCE: Judy Moran - 3300 H.P.
Eugenia Moran - 3500 H.P.

Summary of Points of Interest:

1. Background

This is one of two transits made on the Fortaleza reported on in this study. The ship runs between Puerto Rico and New York on a weekly schedule. In 1977 the ship, under the command of Captain J. R. O'Connor, won the Ship Safety Achievement Award presented annually by the Marine Section of the National Safety Council and the American Institute of Merchant Shipping for saving four lives on the sailing yacht Mystere, 130 miles off Cape Hatteras, North Carolina in a heavy storm.

As the presentation starts the ship is starboard side to the dock on the extreme southwest berth in Port Elizabeth, N. J. Two tugs pulled her off the dock into the channel where she was able to proceed on her own out of the channel, down Newark Bay and through the Newark Bay Draw.[14] Tug assistance was used for the Bergen Point turn into the Kill Van Kull.[15] The observers left the ship at St. George, Staten Island. Consequently, the presentation was concluded just east of the Bayonne Bridge.

2. The Video/Audio Presentation

As the presentation starts all lines are clear and the tugs are carefully working the ship off the dock. The pilot can be heard pointing out the cargo unloading ramps at pier side and noting how far off the dock they extend. The extended position of the ramps requires careful handling of the ship during undocking to prevent accidental damage to the hull.

Since the loading operation has just been concluded the ship is still listing to port. The pilot observes that it takes some time to ballast and trim the ship.

After clearing the dock the pilot uses the ship's power through the channel. He observes an unlighted nun buoy (N "2") dead ahead and notes he must steer clear of it. At night the buoy cannot usually be seen and the apartment building on the far shore is used as an aid to navigation. Both the buoy and the building can be seen clearly as the ship proceeds down the channel.

Several references are made to a drowning that occurred earlier that day in the channel when a tugboat crew member went over the side while helping work a barge around the dock area.

The Judy calls the Bay Draw Railroad Bridge and establishes that it should be open in 7-8 minutes.

Due to technical problems with the video tape a small portion was edited

[14]See Chart Appendix B, p. 11B.
[15]See Chart Appendix B, p. 4B.

out covering the turn and alignment to the Bay Draw. To delay his approach to the bridge the pilot stopped the engines during this period.

As the presentation proceeds the pilot orders dead slow ahead and steady now. A Sealand SL-7 containership, the largest class vessel calling on the Port of New York can be seen off to starboard.

The Bay Draw is raised partially and the pilot orders slow ahead. When it does not go up all the way, the pilot asks the mate on the Judy to call the operator and tell him, "he will need every inch". The bridge goes on up before the communication can be initiated.

The pilot observes that, "being so high up and everything is quiet, that it is very easy to lose your perspective. You need to look out (abeam) and then you see your speed."

As the ship is lined up with the center of the bridge, the pilot orders half ahead. The wind off the port beam is tending to set the ship to starboard. As the ship's bow enters the bridge opening, the pilot has progressively added left rudder until he is hard left to compensate for the set. He then orders midship. As he clears the bridge, he is once again adding left rudder until finally he has hard left rudder. As he approaches Bergen Point he orders assistance from the Eugenia on the port quarter. He gets a little too much help and slows his swing with right 20° rudder as he slows the Eugenia. He later explains that she did not have a line up to the ship and being afraid of sliding off, the tug probably worked harder than ordered.

The presentation is concluded just east of the Bayonne Bridge.

END OF TRANSIT

NAME OF SHIP: Toyota Maru #12

ROUTE OF TRANSIT: St. George, Staten Island to Port Elizabeth, N.J.

DATE: April 27, 1977

SHIP'S DATA:

Registry:	Japan
Type:	Auto Carrier
Size:	DWT: 9,052; LENGTH: 601'; BEAM: 77'
Draft:	20'
Propulsion:	Diesel
Screws:	One

BOARDING: Boarded with the Docking Pilot

TUG ASSISTANCE: Cynthia Moran - 1800 H.P.
Marie Moran - 1750 H.P.

Summary of Points of Interest:

1. Background

The observers boarded the Toyota Maru #12 with the docking master off St. George, Staten Island.[16] The presentation is nearly continuous from a point just west of the Constable Hook Range to berth 25 in Port Newark, N.J.[17] The ship was positioned starboard side to the dock and held in that position for nearly thirty minutes, by the tugs, while waiting for linemen to appear.

The Toyota Maru #12 is 601' in length overall with the navigation bridge forward, 122' from the bows, leaving 479' aft of the bridge. The day is bright and clear with a strong ebb current running against the ship throughout the transit.

2. The Video/Audio Presentation

The presentation starts west of the Constable Hook Range in the Kill Van

[16] See Chart Appendix B, p. 4B
[17] See Chart Appendix B, p. 11B

Kull. Conversation is very general, ranging from the bridge instrumentation, which is very good, and other characteristics of the ship, to language problems that can be experienced on Japanese ships. With respect to the latter, the pilot observes that he usually minimizes what he says for fear some word, or phrase, will be misunderstood as a command. He notes that on two occasions on the same Japanese ship the word "sir" was interpreted as "astern" and the ship was backed.

Some distance from the Bayonne Bridge the pilot says that he just caught himself planning the approach to the turn at Bergen Point (hard on the other side of the bridge). The tide is on the ebb and he notes the complexity of the currents and their respective effects on the vessel at the turn. Because of these currents he says that traffic permitting, he will go a little wide, to the left of the middle of the bridge, and start the bows swinging into the turn before the Newark Bay current hits him. This will permit the bows to be headed more nearly into the current by the time its' full effects can be felt. He observes that if he delays too long, the Newark Bay ebb hitting the starboard bow, when combined with the Kill Van Kull current, that the ship is mainly under the influence of, will make it difficult to turn and tend to push him into the shoals of Shooters Island.

The pilot observes the jackstaff swinging and says that being so far forward and watching "the slow swing of the staff can fool you, because the distance is so short. You look aft and the stern is going like crazy."

The Sandy Hook pilot relays an abbreviated "sea story" and compliments to the docking pilot regarding how well the latter's son handled a ship he was on a short time ago. The docking pilot observes that he is proud of his son's shiphandling ability, but more importantly he feels that "either one has it, or doesn't have it. You can't teach (shiphandling) from books". He believes that his son is one of those that has the "feel" for shiphandling and the natural ability to work out his own solutions to problems.

As the pilot approaches passage through the Bayonne Bridge he orders slow ahead and midships.

(As noted earlier, his planned approach to the Bergen Point turn is to stay to the left of the middle of the bridge and to start his swing for the turn before the Newark Bay current can exert full effects.)

He notes that his earlier order of, "starboard 5° was too much and he is swinging too early". He then orders port 5° rudder to check the swing. He notes, "the streak of the tide," in the area ahead and says that he wanted to be over a little more at this point. He orders midship and notes the ship is still swinging which, "is all right." Then, starboard 5° followed by starboard 10°. As he observes the swing almost stop, he orders starboard 20° rudder and finally hard a'starboard. He asks the mate on the Marie if he has called the Bay Draw The mate says no and the pilot calls the bridge and is advised it is going up. He then points out that by using the black buoy and the land behind it as a range, he can observe the ship sliding to the left, from current effects, even though it is turning. He says that, "we are gaining on the turn" so there is no concern, except that the master told him earlier that he cannot count on the ship backing, it does not back well.

The tugs are told that once through the bridge the Cynthia should get a line up on the starboard bow and the Marie on the port bow. The Marie responds by asking if he wants her to stay with him on the port bow for awhile. After checking on where her line could go, he tells her to go ahead and put the line up and asks the master to drop a heaving line from the main deck.

(Thus the Marie will go through the draw with the ship and the Cynthia will pick the ship up on the other side.)

As the ship completes the Bergen Point turn and is nearly in alignment with the Bay Draw the pilot orders half ahead and midship the rudder. He observes that because of the extensive dredging that has been done to permit the larger container ships more room for maneuvering, the set from both the flood and the ebb tidal currents is toward the east (left to right), thus he will hold to the west as he approaches the bridge. Prior to the dredging, he says, the ebb current set from right to left. The dredging also changed the strength of the current, making it stronger he adds.

The master provides the pilot the height of the highest mast, 104'. The bridge clearance is 135' at mean high water. The pilot observes that he cannot think of a bridge in the harbor that is in line with the channel, everyone of them is at an angle to the ship channel. He notes the bridge opening looks worse than it really is, "because you do have 214' there."

(The chart labels the horizontal clearance of the west draw as 216' and the east draw 134'.)

As the ship approaches passage through the bridge, the pilot observes that he was taught to watch the relative motion of the land beyond either side of a bridge as he approached: If you are standing on the centerline of the ship and the land on one side is moving and the land on the other side is not, then you know you are on a collision course with the bridge. If the land is moving on both sides, but a little faster on one than the other, then you need to give a little rudder. He notes that he is deliberately staying to the left of the green light in the center of the raised span. As the bridge is cleared he orders starboard 10° to follow the channel. The buoy can be seen off the starboard bow as he orders midship the rudder.

At this point in the transit the recording tape came to the end and was replaced. The presentation continues as the pilot steadies up in the ship channel in Newark Bay, just above the Bay Draw. The pilot observes that for many years this was a 400' wide channel, it is now 600'.

The master approaches the pilot and cautions him to "take it easy", presumably because the ship does not back well. The pilot explains the function of the two tugs with lines up to the bows. Nevertheless, it is clear that the master is anxious about the headway and once again asks the pilot to "take it easy". The pilot observes that they are pulling the Cynthia's line up to the deck. He says, "it probably broke". He orders slow ahead.

As the ship approaches the Port Newark Channel, the pilot reviews the situation and talks about the rationale he will use to execute the left turn into the channel. He says, "now we have the ebb current, which is against us, pretty fair with the channel, and I have to make a left turn and go across it. If I were to figure when I start across, it is going to set me down and I went a little high to make that turn to my left...in all probability she couldn't make the turn. You would be entering your bow into relatively slack current and the ebb current out here on your stern would stop your swing. You would be in a bad angle with the channel and she won't come. She will forereach too much and will run out of the channel. So you start your turn as though the current was negligible. Then you come up into the current. In making a left turn you are creating an arch. It's like having milk in a bucket and swinging it around, the milk will stay in, the same thing happens. She will have a tendency to go up against it...When you get her going that way, things in motion tend to stay in motion. She will lift herself right over.

You can't do this going into a dock...because you can't have the speed. You do use that (headway) a little bit to keep her going, you know, helping yourself all the time."

(When a ship is underway, control is exercised through the engine and rudder acting at the stern. As the rudder is put over the stern is forced in the opposite direction. As the hull begins to move away from the original line of forward motion, significant resistance begins developing along the hull of the ship in the direction of the turn. The forces from the screw current are also being diverted in the direction of the turn. Thus the combination of rudder forces, forces resisting the sideways motion of the hull and the screw current all work to push the ship in the direction of the turn. As the turn continues, the centerline of the ship is inclined towards the center of the turn; the stern swings outside the path and the pivot point of the ship follows a smooth arch along the mean path of the turn.)

As he is ready to make his turn he orders port 10° and says, "once we stick her bow past that beacon the water that is coming over those flats is only about a foot or so deep, so there is no volume of current, where the stern will still be out in the 35' channel, in that volume of water". Easy 5° port. He then orders the tugs to switch from channel 13 to 7A on their radios to insure less communications congestion and interference with other ship traffic. Since the swing is continuing he orders midship to ease the swing. As the swing nearly stops, he orders stop engines. He then orders the Marie (port bow) to go back and rudder hard a port, saying the swing started the other way. Gradually the swing picks up again to port. He then orders the Cynthia (starboard bow) go back and rudder midships. The engine is ordered half astern.

The pilot moves to the starboard bridge wing and the camera follows. The camera view is now looking aft from the starboard bridge wing. While the shift is taking place, the pilot orders the Cynthia to the port quarter.

He then orders the ship slow astern. He says that normally he would have made a different approach, but when he is told the ship does not back well he doesn't "point (the ship) at anything and keeps it away from everything." He then orders stop engine.

Referring to a chart showing the berths at Port Newark, berth 25 is the second berth in on the north side.[18] He concludes that he is nearly in position and needs only to push her into the dock. The Marie is ordered 1 bell (half speed). He notes that the ship is "just about dead in the water." As the Cynthia arrives in position on the port quarter, she reports that she is pushing, hooked-up (full ahead).

(She initiated this action without a direct command from the pilot. The mate's action is based on his understanding of what is needed. He can view the position of the stern, has heard the command to the Marie, recognizes the ship is dead in the water and knows it is some distance from the berth.) The pilot acknowledges the Cynthia and orders the Marie hooked up.

In discussing the depth of the channel, the pilot says that it is advertised as 35', however, judging from the mud the ship is sucking to the surface he does not believe it, noting that with our draft of 20' we should not disturb the bottom of a 35' deep channel. Both tugs are ordered 1 bell (half ahead). Marie is then ordered easy ahead. Later Cynthia dead slow ahead. He then orders both stopped and stay in position for a back if I need it. He observes that he must keep in mind that the lines from the tugs are all the way up to the main deck. Thus, if he needs them to back he must anticipate the action early in order for them to back far enough for the line to come tight. And even so, with a line up like it is, the tug must tighten up easy to prevent even the strongest line from parting.

[18] See Chart Appendix B, p. 11B.

(The pilot is identifying another benefit of the panama, or pocked chock. In addition to allowing the crew of the assisting tug to handle their own lines to the ship, the response time of the tug can be reduced with less risk of mishap.)

As the bows move in ahead of the stern he orders the Cynthia ahead 1 bell saying, that by her pushing ahead the bows should slow. As the ship continues to move to the dock the bows remain somewhat ahead of the stern and the pilot orders Marie, go back Marie. Cynthia stop. Marie stop. Marie ahead easy.

To this point no linemen have appeared to tie the ship to the dock. The pilot says, "It's a beautiful day, what if it was blowing a gale?" Speaking with a man on the dock regarding the absence of linemen, he is told that the person is only a spectator. The pilot then reports the lack of linemen to the Moran dispatcher. In the meantime, he continues to use the tugs to hold the ship to the dock. Eventually, linemen appeared and assisted in tying the ship to the dock. The video recording was concluded some twenty minutes before their arrival.

END OF TRANSIT

NAME OF SHIP: Oriental Statesman

ROUTE OF TRANSIT: St. George to the East Berth of the Global Terminal, Bayonne, N.J.

DATE: May 2, 1977

SHIP'S DATA:

Registry: Liberia

Type: Container Ship

Size: DWT: 20,500; LENGTH: 683'; BEAM: 100'

Draft: 30'

Propulsion: 2 Steam Turbines

Screws: One

BOARDING: Boarded with docking pilot

TUG ASSISTANCE: Eugenia Moran - 3500 H.P.
Christine Moran - 1200 H.P.

Summary of Points of Interest:

1. Background

The observers went aboard the Oriental Statesman with the docking pilot off St. George at 0515. As sufficient ambient light became available, the video camera was activated. The ship's position is just south of the Military Ocean Terminal.[19] The docking orders called for the ship to be positioned port side to the east berth of the Global Terminal. This required the pilot to proceed to the turning basin at the western end of the terminal, turn the ship and return to the berth for docking. The channel and turning basin is quite restricted for this size vessel.

The pilot does a good job of explaining a complex series of maneuvers.

[19] See Chart Appendix B, p. 4B.

One that could not be explained involved an instance of the ship's backing to starboard rather than to port as was expected.

2. The Video/Audio Presentation

The presentation starts with the vessel approaching the south end of the Military Ocean Terminal. The pilot is talking about the differences in engine response between different ships, particularly those with steam turbine and those with diesel propulsion, using the same standard engine order. He notes on some ships, slow ahead is too slow while half ahead may be too fast for a given situation.

As the ship enters the terminal area, the container cargo docks can be seen ahead on the starboard hand. The vessel is to be docked port side to the east berth (first set of cranes), requiring the pilot to proceed beyond the cargo docks to the turning basin at the west end of the terminal area and return.

For the size of the vessel the maneuvering area is very limited, requiring careful control of rudder and engine. The pilot points out that on steam turbine ships the engineers never stop the "wheel" entirely with the stop order and that it continues to turn slowly in the direction of the last order, ahead or astern. The pilot must anticipate the effects of the slowly "flopping" wheel in his maneuvering.

The master advises the pilot that she "backs very slow." He says it takes about 30" after the order before the ship starts to respond. The pilot then orders the <u>Christine half astern</u> and then the ship's engine <u>slow astern</u> in anticipation of his approach to the turning basin. The Eugenia is ordered to slide up on the port bow farther and keep the bows straight. The bows can be seen falling off to port and the Eugenia is ordered half ahead, with the pilot commenting that normally the ship "should back to port, but this one is backing to starboard."

(Backing to starboard is not the usual response from a single, right hand turning screw, ship. They normally back to port. Undoubtedly this one normally backs to port also, as is demonstrated later in the docking maneuvers. No explanation for the anomaly is offered, but most likely it occurred because the ship was "smelling" a high spot on the bottom of the channel.)

He notes that he had intended to turn the ship around to port (he now appears to be less certain of that maneuver). He follows by noting that you have to be careful when a tug (Eugenia) is at this angle (to the ship), "he is pushing the bow over but is also giving you a little headway". Engines are ordered half astern. As the swing to port stops and the bows start swinging to starboard, the engines are stopped, the Eugenia stopped and the Christine stopped. The pilot then observes that he is going to keep with his original intention of turning to port, saying that he would have to switch his tugs all around to go the other way.

(With the left turn he needs simply to move the Christine forward to the starboard bow and the Eugenia aft to the port quarter, which he does as he goes out on the bridge wing. These orders are not heard on the audio track. Still another consideration that probably contributed to the original decision to turn to port, although we cannot verify, is the fact that right hand turning, single screw ships turn easier to port with the engine moving ahead than they turn to starboard. This is because the side forces generated by the propeller work with the rudder forces when turning to port and work against the rudder forces when turning to starboard. Consequently, other factors being constant it is easier to turn a ship to port.)

The camera is moved to the starboard bridge wing. The pilot orders the tug positioned on the port quarter, Eugenia, half ahead. He explains that when turning in a basin it is very difficult to judge if the ship has headway, or sternway, because the pivotal movement makes it difficult to judge the fore and aft movements.

(Obviously, in a small turning basin, *undetected fore and/or aft* movements could result in a grounding. In part, the mates on the tugs help with this problem by keeping the pilot advised as to the distance off obstacles.)

The engine is ordered slow astern and the Christine (starboard bow) dead slow ahead in anticipation of the normal "back-to-port" characteristic of the ship. He then orders the Eugenia hooked up; noting that at this angle the Christine is still providing forces that can create headway that he must watch carefully. He says that these forces would be even more critical if there was more current. The pilot orders, stop engine. The engine is later ordered slow astern. The pilot says "with the turbines...you have to stop before you really want to stop. The engines are geared so slow that...the engine will keep going in reverse for, I think the captain said 30 seconds, before you can stop the engines." He observes the tug on the bow and says, "we have a little sternway now. See how she is angling the other way now?" The engine is ordered stopped. He then asks the master to have the mate on the bow report *clearance off* the buoy.

(At various times during the turn the Eugenia reports the position off the buoy aft and the master relays similar reports from the mate on the bows.)

The engine is ordered dead slow ahead to adjust position to the middle of the basin. Engine is ordered stop as the pilot says, "I can tell by his quickwater (forward tug) we are getting a little headway".

(Here the pilot is referring to the relationship of the tug's propeller wake to it's centerline. In order to hold the tug straight into the ship the mate is using a little left rudder which is diverting the wake of the tug towards the stern of the ship.)

As the headway is reduced and the turn is nearing completion, the pilot orders dead slow ahead on the engine and hard port rudder to assist the tugs in completing the turn.

As a new video recording tape was being installed, the pilot ordered the Eugenia move to a position under the starboard bridge wing and put a line up to the main deck. She later reported that she had to move just forward of the bridge to reach a chock for her line. The pilot approved.

As the presentation continues, the ship is approaching the dock from a position in mid-channel. The pilot explains that if your approach is too close to the dock and you need to back to reduce the headway, the port stern may hit the dock before the tugs can assist. With the bows angled in a little, he can back the tugs to reduce headway and minimize the amount of backing he must do with the ship's engine. He notes that if the wind was blowing, the whole situation could change depending on it's direction and force. He further observes that any maneuver is based on the assumptions that certain things, that should happen, will happen. He recalls that on the way in the ship did not back to port as it should, rather it backed to starboard. "But you always expect what should happen, even though sometimes it does not."

As the bow starts to swing to starboard, he orders the Christine half ahead. The engine is ordered slow astern, he observes that "turbine ships have very good power, as a rule not as good backing power as that ahead. They are slow, but once you get the power it's very good." The Christine is ordered stop. He continues with the power characteristics of turbine ships saying that they can mix you up, because "you may be slow astern and not getting the full response you want and order half, suddenly you have much more than you need". The Eugenia is now ordered dead slow ahead to assist in moving the stern towards the dock. Christine half ahead to hold the bows from swinging to starboard. Eugenia stop, to allow the gentle swing of the stern to continue. He observes that this time the ship is backing to port. Engine stop. He asks the Eugenia if she can back and is advised yes. He then orders her to back easy into her line to slow the stern swing to the dock. Later, Eugenia stop. He checks with the master about positioning at the dock. He then orders, Eugenia dead slow ahead. Christine stop. Dead slow ahead on the engine to move ahead 15 feet. Christine ahead easy. Stop engine. Eugenia dead slow ahead. Eugenia stop. Slow astern, engine. Half astern, engine. Christine half ahead. Eugenia work ahead a little. Stop engine. Eugenia half ahead. Christine hooked up. Eugenia hooked up. Eugenia easy, Christine half ahead. He now is told he needs 25 feet ahead and orders engine half ahead. Christine easy. Eugenia stop.

(Another Moran docking is taking place. Orders to the Cynthia can be heard on the company channel.)

Christine stop. Stop engines. Christine half ahead, Eugenia ahead easy as both tugs are worked to keep the ship against the dock. The master is directing the line handling activities of the deck crew and keeping the pilot advised. Eugenia and Christine hooked up. Eugenia easy, Christine easy. The ship is in position, spring lines are out and the presentation is concluded at 0623 hours.

END OF TRANSIT

NAME OF SHIP: Rio Iguazu

ROUTE OF TRANSIT: Port Newark to the East side of the Bayonne Bridge

DATE: April 28, 1977

SHIP'S DATA:

Registry: Argentina

Type: Freighter

Size: GT: 10,410; LENGTH: 484'; BEAM: 66'

Draft: 14'

Propulsion: Diesel

Screws: One

BOARDING: Boarded with the Docking Master

TUG ASSISTANCE: Marie Moran - 1750 H.P.

Summary of Points of Interest:

1. Background

The Rio Iguazu was berthed on the north side of the Port Newark Terminal channel, starboard side to the dock. The pilot undocks the ship and turns her 180° in the channel using the assistance of one tug.

As he enters Newark Bay Middle Reach Channel a strong ebb tide is running behind him and winds from port are gusting 10-15 knots. The Bay Draw is down awaiting a scheduled train passage. The draw operator advises a 10 minute delay in raising the bridge. Using the tug and the ship's engine and rudder the pilot holds well above the bridge. After the 10 minutes delay the train has not arrived and the operator raises the drawbridge allowing the Rio Iguazu to pass. The presentation continues around Bergen Point and through the Bayonne Bridge.[19]

[19]See Chart Appendix B, p. 11B.

The pilot's explanations of the variety of maneuvers involved are good, particularly the undocking, turning and holding actions above the Bay Draw.

2. The Video/Audio Presentation

The ship is berthed starboard side to the dock. The presentation starts with the undocking maneuver. With one assisting tug the pilot positions it on the port bow and has it "pinch" the bows into the dock. This action shifts the pivot point far forward and moves the stern away from the dock. Once the stern is off the dock the tug is ordered to lift the bows off the dock. With a line up to the main deck, the tug backs and pulls the bows off. The rudder is ordered <u>hard starboard</u> and the engine <u>dead slow ahead.</u> These actions on the ship will assist the tug in bringing the bows off the dock. A 10-15 knot wind off the dock also helps.

The pilot observes some of the differences between diesel propulsion and steam turbine propulsion, namely, the quicker and stronger reactions of the diesel engine, particularly in maneuvers demanding slow engine reactions.

The engine is ordered <u>stop</u> and rudder <u>midships</u>. The engine is then ordered <u>slow astern</u> and the Marie <u>ahead easy</u>.

(With the engine going astern the ship is initially backing at a small angle towards the center of the channel. Since the ship characteristically backs to port, the angle towards the channel becomes greater as the stern begins to swing to port. Since the object here is to turn the vessel 180° to leave the channel, the Marie is ordered to push the bows around easy.)

As the ship backs to a point which the pilot judges to be far enough into the channel to permit the bows to clear the dock, the pilot orders <u>stop the engine</u>.

A brief conversation with the mate on the tug is barely audible, but as the pilot notes later, the mate was advising him that he was far enough off the dock to complete the turn and the pilot ordered her half ahead. Then hard a'starboard and Marie hooked up (full ahead). The engine is ordered slow astern. (The actions move the pivot point near the center of the ship and allow her to swing around in her own length.) He then orders stop the engine, Sir. Then slow ahead, Sir. Midship and the Marie all stop. With the forces creating the swing removed, the vessel continues to "coast" on around. (The camera is moved into the wheelhouse.)

As the presentation continues the engine is slow ahead and rudder midship. As the swing to starboard slows, the rudder is ordered starboard 10°.

As the ship approaches a vessel docked on the port hand, he orders the engine dead slow ahead to prevent possible damage to the moored vessel. He then orders the helmsman to steady the ship, i.e., stop it's swing. At this point the ship has been undocked and turned 180°, on a heading leaving Port Newark.

(The viewer's attention is invited to the visibility problems presented by the location of the cargo booms on the main deck. Conning position #1 at the centerline of the ship, the position from which the ship's heading can normally be best viewed, is totally blocked. Alternative conning positions #2, left of centerline, and #3, right of centerline, offer only marginal improvements in that spinning, rain windows are installed.)

The pilot says he is heading the ship at the N "18" buoy marking the red side of Newark Bay Middle Reach Channel. Although he cannot see it without moving from his conning position out to the bridge wing, he estimates it's position by observing the "19" buoy to port and the "1" buoy to starboard, marking the entrance to the Port Newark Channel.

The pilot notes that the tide is now on the ebb and the observer mistakenly identifies a container ship at the dock as an SL-7. The pilot is giving helm orders in the language of the ship, Spanish.

The mate on the tug calls the operator on the Bay Draw Railroad Bridge to request that it be opened. The operator advises that he cannot open for 10 minutes. The pilot observes that with the tide on the ebb, fair behind him, he will be at the bridge in 10 minutes. To allow some margin of safety, he says, he will slow the ship down. Engine is ordered dead slow ahead.

(This bridge is a continuing source of delay in and out of Newark Bay. It also represents the biggest single hazard to navigation in the area. During the course of this study we observed several instances of 10 to 15 minutes delay with vessels from this size to an SL-7 holding above the bridge on an ebb tide.)

The pilot notes the Fortaleza and observes that he was on the Tohbei Maru (see the inbound transit of the Fortaleza) just ahead of her this morning.

The pilot orders the engine stopped from dead slow ahead to delay his advance to the bridge. The bows begin to fall off to starboard from wind effects and he orders the Marie, with a line still up on the port bow, to back easy. He assists the tug with dead slow ahead on the engine. As the ship straightens, he stops the engine and the tug. The pilot makes the point that this is the reason he is holding the ship this far above the bridge. The need for such maneuvering near the bridge is hazardous. The camera pans the "12" buoy where the strength of the ebb tide is clearly visible. He then orders, Marie, on back, Marie, as the bows again start to fall off the heading. He finally orders dead slow ahead and hard a'port. As the bows go the other way he stops the engine and the Marie.

The pilot calls the Bay Draw and is advised that the train is late and the bridge is going up to allow him to pass through.

The mate on the tug gives the security call and the pilot asks the master the mast height for clearance under the Bay Draw. The reply is 110' with this draft. Vertical clearance on the bridge is 135 feet.

The pilot maneuvers the ship to a position to the right of the bridge. He explains that this is due to the "hump" marked by a can buoy on the other side of the bridge. Approaching from this side avoids the need to make a hard turn immediately after passing through the bridge.

As the pilot maneuvers just above the bridge, he orders the engine from slow ahead to half ahead to provide additional rudder power and orders the rudder starboard 10° to hold the ship up into the wind. The helmsman does not speak English proficiently and misunderstands the rudder order and starts to port. The pilot, checking the indicator, quickly catches and corrects the error. The master immediately resumes translating helm commands from English to Spanish. As the ship passes through the draw, the pilot notes that he is favoring the windward side.

As the Bay Draw is cleared the pilot orders dead slow ahead and notes that he likes to approach Bergen Point as slow as he can so if he needs more rudder power to make the turn he can use the engine briefly without gaining too much headway.

A tug pushing a derrick passes, one whistle, well on his side. As the turn is initiated with port 10° rudder the response is slow and the pilot orders port 20°. He then orders slow ahead to increase headway and probably rudder power. The rudder is eased to port 10°, then to midships. As the swing slows he orders port 10°. The pilot asks the master the speed of the ship on half ahead. It sounds like he says 12, which seems too high. The master later says something else that may be the answer to the pilot's question.

Rain squalls are in the area and the pilot estimates visibility in the Kills at 1½ to 2 miles.

The pilot relates another experience he had in the area when the helmsman put the wheel the wrong way.

He drops speed to dead slow to reduce the wake while passing the shipyard and oil terminal just beyond.

END OF TRANSIT

NAME OF SHIP: S. S. Arco Prestige

ROUTE OF TRANSIT: Stapleton Anchorage to Tremley Point, N.J., via St. George, Kill Van Kull and Arthur Kill

DATE: March 2, 1978

SHIP'S DATA:

Registry: United States

Type: Tanker

Size: DWT: 34,124; Length: 670'; Beam: 83'

Draft: A 30'

Propulsion: Steam Turbine

Screws: One

BOARDING: Boarded with the Docking Master.

TUG ASSISTANCE: Providence - 1800 H.P.
Helen McAllister - 3200 H.P.

Summary of Points of Interest:

1. Background

The docking master was contacted on his tugboat by his office, via the VHF radio, two days prior to the transit with a request to provide a schedule for moving the vessel on March 2. The ship was required to unload part of its' cargo at Tremley Point (located in Arthur Kill west of Prolls Island) and then proceed to Yonkers with the balance of the cargo. The dispatcher requested recommendations regarding the transit route for both moves. There are two possible routes to Tremley Point from Stapleton Anchorage.[20] One, Stapleton out to sea through Ambrose Channel and back in via the southway behind Staten Island to Tremley Point, approximately 39 miles. The second

[20] See Charts Appendix B, pp. 4B, 11B, 12B for shortest route and charts 4B, 3B, 2B, 16B, 15B, 14B, 13B, 12B for alternative route.

route is via the Kill Van Kull and Arthur Kill, approximately 11 miles. One of the questions asked by the dispatcher involved the possibility of turning the ship at Tremley Point, if the second route was used, thereby avoiding altogether the need to go into the lower bay with it's added mileage and the cost of a Sandy Hook Pilot. The docking master recommended the ship be moved through the Kill Van Kull and Arthur Kill to Tremley Point; that it not be turned; that when the discharge at Tremley Point was concluded the ship be moved on around Staten Island into the lower bay and back up into the upper bay and the Hudson River to Yonkers; and that the ship leave the anchorage at 1300 hours on March 2, 1978. The recommended time of movement was based on the deep draft of the vessel, the amount of water alleged to be at the dock at Tremley Point and the tide and current conditions to be expected at that time of day, taken from the towing company's tide and tidal current tables. Upon reporting these recommendations to the dispatcher, the pilot was advised they would be passed on to the customer and he would be further advised on the movement. Sometime later the dispatcher confirmed his planning recommendations and assigned him the job scheduled for 1300 hours March 2nd.

At about 1200 hours on March 2nd, as the tugboat approached the anchorage, it was observed that the Arco Prestige was underway and moving towards St. George and the Kill Van Kull. This was puzzling to the docking master since he had carefully planned the transit to arrive at Tremley Point on the high water. With a deep draft of 30', near high water at the dock was needed to insure safety for docking and cargo discharge operations.

Upon boarding it was found that a Sandy Hook pilot was at the conn and general confusion existed regarding the timing of the movement and why the Sandy Hook pilot had been hired. As the respective pilots and the ship's master exchanged information, it became clear that the confusion had resulted from decisions made on behalf of the ship by company personnel working in another city who had too little appreciation perhaps for these types of problems. Furthermore the decisions, once taken were somehow not passed along to the ship's master or the pilots. Following these "sorting out" discussions, the docking pilot relieved the Sandy Hook pilot and the latter left the ship via the tugboat.

The consequences of this failure of communication between the ship's company shoreside personnel, the ship's master and the working pilots were: 1) the ship hired a pilot that was not needed; 2) it left the anchorage before it should have done so, requiring the docking pilot to proceed more slowly than he would have preferred while trying to make up the additional hour of the flood tide (high water) that he lost at the start, only part of which he was able to retrieve; and 3) once at the dock he was working with minimum water during the docking. The latter consequence, combined with the faulty operation of a capstan being used to take in an after spring line, added to the time required for docking the vessel. As it turned out, once the vessel was against the dock, spring lines were ordered fore and aft to assist in holding her position. The after capstan failed to function properly and tension could not be applied to that line. While using ship's power to alter final position to permit hookup of cargo discharge equipment, the combined effects of minimum water under the keel, the forces exerted by the screw against the bottom and the hull began to move the stern from the dock. Tug forces were not sufficient to hold the ship and she moved away about 40 feet, thereby requiring additional maneuvering to once again bring her into position. It should be noted that the entire maneuvering situation was complicated by the urgent need to start discharging operations as quickly as possible so that the vessel could be pumped down to a safe draft before the next low water.

Unfortunately, the video presentation does not include these last docking events. This is because they were not anticipated and the video equipment was being disassembled and stowed in preparation for leaving the ship at the time of their occurrence.

2. The Video/Audio Presentation

Recording started in the Constable Hook Reach in the Kill Van Kull.[21] The pilot positioned himself at conning position #2, approximately 8 feet to the left of the centerline of the vessel and the video camera was mounted approximately 10 feet to the right of the centerline. One of the ship's VHF radios, tuned to channel 13, was mounted directly under the window at conning position #2. The pilots' portable radio was tuned to his company channel, which was also being monitored by the assisting tugboat Providence.

The docking pilot orders the tug Providence to the port side for the purpose of taking off the Sandy Hook Pilot. Following this the docking pilot engages the master in a social conversation.

(Such conversations are useful in establishing rapport and providing for a more relaxed working environment. They also appear to be used by pilots to establish their "credibility" with the master. Referring to a relief master, or mate by name, who they know has served the ship, makes the

[21] See Chart Appendix B, p. 4B.

master aware that the pilot knows the ship, has handled her before, has many years of piloting experience and so on. This conclusion, of course, is only conjecture but has been noted frequently enough to tentatively classify the behavior as one of several techniques pilots use to relate, positively, to bridge personnel.)

Later the pilot asks if the bow thruster is working. He is told yes and the pilot and master comment about the difficulty of starting it in the wintertime.

The pilot provides information regarding the Port Richmond range.[22] Although the audio is difficult to understand due to noise interference and the pilot's soft manner of speaking, he essentially identifies a concrete pier that he is using to position the ship. The after light of the old Port Richmond range no longer exists. The pilot observed that someone put up a building blocking it and it was subsequently taken down and not replaced. He indicated it had been gone for about 15 years.

As the pilot turns away from the Port Richmond range he heads the ship towards the Bayonne Bridge. When asked what he is using as a steering aid, he identifies a nun buoy under the right side of the bridge. He notes that he wants to be well on his side of the channel in the event that something comes around the Bergen Point turn, hard on the other side of the bridge.

(The difficulty in establishing the heading of a ship when the conning position is other than at the centerline can be noted in these scenes. The camera is about 10' to the right of the centerline. In the absence of steering poles or other readily usable aids, exact heading is difficult to determine.)

As the bridge is approached the pilot orders <u>left 20°</u> rudder and begins steering to the center of the bridge. He issues a security call and orders <u>midships</u>. The ship swings past the center of the bridge and the pilot checks

[22] See Chart Appendix B, p. 11B.

the swing with right 20°. The Newark Sun is coming down Newark Bay and responds to the security call. She is advised that the Arco Prestige is going to Tremley Point and should be well clear of Bergen Point before she arrives there. The swing of the ship is checked and the rudder is ordered midships.

(As the ship approaches Shooters Island the camera picks up important landmarks on the Elizabethport shoreline that are frequently used by pilots to help identify their position in the channel: By observing the beacon R "16" in relation to the ship, the Singer building and the water tower to the left of the building, pilots can determine which side of the channel they are on. If they are on the north side, the ship, the beacon and water tower are in line. As the line through the beacon shifts to the right through the letters on the building the ship is progressively positioned towards the south side of the channel.)

The turn around Shooters Island is executed well to the right (north) side of the channel. To provide additional rudder power for the turn the pilot orders half ahead on the engine.

As the ship moves into the North of Shooters Island Reach, the pilot identifies the Elizabethport range[23] and notes that there is "only one light on this one also." The second light "has been gone as long as the one at Port Richmond."

The pilot notes the tidal current effects on the "17" buoy. The ship is now stemming the tide under the influence of the flood coming in through Arthur Kill.

The tug Helen McAllister joins the ship to assist in the docking. The pilot asks the master to have the crew make her line fast on the port bow.

As the pilot orders left 20° to start the turn at Port Ivory the camera zooms in on the Elizabethport day marker. The ship readily responds to the rudder, even though the current at this point sometimes makes the turn

[23] See Chart Appendix B, p.11B.

difficult (see discussion of the Port Ivory turn during the transit of the Great Republic.) The Howland Hook Railroad Bridge can be seen in the background and the Howland Hook container terminal can be seen to the port hand.[24]

As the turn is completed the pilot steadies up the ship on the center of the bridge and issues a security call. He then orders the helmsman steady as you go now.

At the bridge the pilot orders left 20° rudder and half ahead. The engine has been dead slow ahead. The pilot increases speed in anticipation of the turn at Bayway, calling it one of the worst turns in the entire harbor. He later explains that the flood tide "bounces" off the shore at Bayway and sets the ship to the Staten Island shore. He also notes that the flow from Morses Creek results in brackish water which effectively increases the draft of the vessel.

(The specific gravity of salt water is 1.025. Fresh water is 1.000. Brackish water will be somewhere between the two, depending on the mixture. As the water becomes less dense, salt to fresh, the draft of the vessel increases. Fresh Water Allowances are calculated for each vessel in accordance with load limit regulations. Given the known Fresh Water Allowance and density of the water, changes in draft can be easily calculated, or taken from tables, as needed.)

As the current coming off the Bayway docks hits the bow, the pilot orders right 10° rudder to counter the force. As the ship moves deeper into the turn he orders midship and then left 20° and finally hard left rudder as the main current begins to hit the port bow. The turn is nearly complete when the pilot orders midships. The swing continues beyond the center of the channel and he corrects with right 10°. The swing is checked and the ship is lined up on the range at Tremley Point. He then orders steady as you go to permit the helmsman to steer on the range.

[24]See Chart Appendix B, p. 12B.

The pilot gives a security call at the upper end of Grasselli.

A discussion is renewed (see the transit of Barge Stonybrook) about the congestion created on channel 13 by the high wattage transmitters in common use.

(The pilots' position is that transmitter power should be restricted to that required for 2-3 miles transmission. This would clear the congestion that frequently occurs on channel 13 without loss of information important to traffic movements.)

The camera zooms on the berth dead ahead at Tremley Point and the observer attempts to encourage the pilot to talk about his strategy for docking. Some useful comments are provided by the pilot.

The pilot orders hard left as he begins to position for docking. He orders the tugs into position, with the Providence (1800 hp) near the rudder with a line up to provide additional rudder power and the Helen McAllister (3200 hp) on the forward port quarter with a line up.

(As the headway is reduced, control of the bows, using ship's engine and rudder diminishes, whereas the ship's engine combined with the help from even a small tug can usually provide satisfactory control of the stern. Thus, all other factors being constant the pilot will assign the most powerful tug the heavier work at the bow.
The audio for the docking events lack continuity, due primarily to two factors. First, in the early stage of docking the pilot was on the move: From wheelhouse to starboard bridge wing and back several times, with various intermittent positions. Later as the vessel comes closer to the dock and is positioned at the angle the pilot desired, he stayed on the extreme end of the bridge wing. From this position he could readily observe the swing of bow and stern as well as the entire starboard side of the ship, the amount of way on the ship, the wake and quick water generated by the ship's wheel, and the entire dock. It might be noted that he could not see a rudder position indicator, or engine order telegraph. Consequently, he had to rely on the mate in the wheelhouse to insure that his commands were promptly/correctly carried out. The wheelhouse crew spoke native English and appeared to be totally experienced and competent. The master likewise remained for the most part on the bridge wing and the open deck running aft alongside the wheelhouse. During the last stages of docking the master interpreted the

positioning orders being given from dockside and controlled the line handling activities of the deck crew.

Still another reason for the general lack of continuity in the audio portion of the docking rests with the manner in which tugs are controlled. The pilot uses his portable VHF radio to give orders to the tugs; they respond with whistle signals, or radio, indicating their understanding and initiation of the order. Frequently, these orders are difficult to pick up with the microphone, particularly on an open bridge with accompanying winds and the pilot hanging over the side.

With these shortcomings in mind this narrative description will attempt to detail the docking maneuvers, some of which admittedly require listening to the tape several times.)

As noted earlier, the pilot initiated the docking maneuvers with hard left rudder. The engine was dead slow ahead. Careful observation of the video indicates that the bow does not swing under these conditions, probably due to the combination of flood tide striking the port bow and the diminished forward speed. Nevertheless, the hard left rudder and dead slow ahead are having the desired effects. By observing the edge of the TV screen, the slow swing of the stern to starboard can be detected. This scene makes it clear why the pilot must be on the bridge wing to properly assess the total actions of the ship. Also, in this case a good portion of the overall length of the vessel is aft of the bridgehouse.

The Providence asks the pilot if she should have a line up. This question was probably prompted by the lack of action on the deck of the ship to accept a line, rather than a lack of "knowing" on the part of the mate. The pilot then asks the ship's mate if he can get someone to take a line from the tug on the after port side. Shortly afterward, but before the line was up, he ordered the Providence <u>half ahead</u> and, although we cannot verify, the Helen <u>half astern</u>.

The pilot orders engine stopped. The engine order telegraph alarm can be heard in the background. The bows start to swing evidencing the forces being applied and the pilot orders both tugs to go easy. Shortly afterward he orders both stop. He then orders rudder midship and dead slow ahead.

As the swing stops the pilot orders hard left rudder. Casual observation of the video for the next few minutes does not reveal any significant movement. The bow does not appear to swing, but watching the edge of the TV set permits detection of movement, either ahead, the swinging of the stern, or both. The camera pans abeam to provide a better view of the headway. From this viewing angle headway is easily detectable. Headway is usually best judged by viewing the relative motion of fixed objects directly abeam of the ship.

The camera is carried out to the bridge wing and the swing of the stern can be viewed.

The pilot orders stop the engine and rudder midships. At this point the pilot intends to allow the ship to drift toward the dock until he is in position to permit the tugs to push him in.

(The pilot and master engage in a "social" conversation, the first for some time. Even the observer joins in on this one. Although largely speculation, it is nevertheless suggested that two occurrences are behind this rather spontaneous behavior. First, it tends to relieve the tension that builds from the concentration demands the job places on the pilot. Such an off-the-subject conversation, or even a wisecrack on occasion, tends to break the tension. Indeed sometimes an observer can become so engrossed in the operation that he is generally unaware until the break just how "heavy" the tension was. Second, the off-the-wall comment (s) usually indicate a period of "let's wait and see now how things develop".)

The camera pans abeam providing a view of the headway and a shot of the stern indicates all swing has stopped. The pilot orders the Providence to come ahead easy towards the dock. He then orders ship's engine slow astern to further reduce the headway. A little later he orders the Providence half ahead, probably, in part, to offset the tendency for the ship to back to port. He also advises the master that they should prepare to get two spring lines to the dock.

The master has been watching the dock superintendent and is told that the ship needs to be fifty feet ahead (to be in position to connect the cargo discharge equipment). He relays this information to the pilot. A few seconds later the master advises the pilot that 10 feet ahead will put the ship in position. The pilot orders half astern on the engine. The dock superintendent advises that they are lined up and the master notes that all we have to do is get her in. The pilot notes the wind is pushing off the dock; the ship is half astern, rudder midships; the Providence is working half ahead to the dock, and the Helen is slow ahead to the dock.

The pilot orders stop the engine and the video scene indicates a slow movement of the stern to the dock.

The Helen is ordered half ahead, followed by orders of easy to both tugs.

The master advises the pilot that they must go back 10 feet.

The pilot orders the Helen to stop now and shouts to the main deck his need for two, not one, spring lines.

The pilot tells the master that he should be done with the "wheel". (This frees up the helmsman for other duties if he is needed.)

The balance of the presentation deals almost exclusively with the problems of lining up the ship's cargo discharge equipment with that dockside. The dock superintendent judges the ship must go astern 12 feet and the pilot orders engine slow astern. Throughout the tape the tugs are ordered alternately and sometimes together to hold the ship close to and parallel with the dock. The first line goes to the dock at approximately 1400 hours and the pilot notes the time. As the dock superintendent requests 5 more feet astern, the pilot orders the engine stopped. Less than a minute later the master says she is in position and orders her tied up. The camera was stopped and the video equipment was disassembled and stowed in preparation for leaving the ship. Subsequently the dock superintendent noted that the vessel was not yet positioned properly and the need to use the ship's engine for the "new" position precipitated the stern off-the-dock situation noted at the beginning of this narrative. This was subsequently corrected and the ship was tied up.

END OF TRANSIT

NAME OF SHIP: Tugboat Providence and Barge Sparkling Waters

ROUTE OF TRANSIT: Stapleton Anchorage to Grasselli, N.J. via St. George, Kill Van Kull, and Arthur Kill[25]

DATE: March 2, 1978

SHIP'S DATA:

Registry:	United States
Type:	Tugboat and Barge
Size:	Tugboat - Length: 105 feet Barge - Length: 300 feet; Capacity: 25,000 bbls.
Draft:	Tugboat: 12 feet Barge: 4 feet
Propulsion:	Diesel 1800 H.P.
Screws:	Tugboat: One Barge: Unmotorized

BOARDING: N/A

TUG ASSISTANCE: N/A

Summary of Points of Interest:

1. The Barge Sparkling Waters carries chemical by-products that are routinely disposed of 100 miles off the coast of the United States. The Redstar Tugboat Cheyenne had made the overnight trip and had just turned the barge over to the Spartan for it's return to the chemical plant berth in Grasselli. Shortly after the order was given the Spartan the Providence became available and the job was reassigned due to the Providence's larger size and power.

A small harbor tanker was unloading at the dock where the barge was to be tied up and was giving an estimated time of departure of two hours from the time the Providence began the transit. Even while stemming

[25]See Charts Appendix B, pp. 4B, 11B, 12B.

the ebb tide from Stapleton to beyond Shooters Island the entire transit could be made in about one hour and 15 minutes. Thus the mate, who had the watch, concluded he had to "kill" some time.

Before reaching the dock at Grasselli the sun set and the ambient light dropped below the level needed for the video camera and the recording was stopped. Shortly afterward, the captain relieved the watch.

Upon approaching the berth the tanker was called and asked his departure time. He responded that he was "casting off lines." With the fair tide and winds gusting off the dock, the barge was difficult to hold in position, so the captain started rounding-up, i.e., making as wide a turn as the channel width (approximately 500 feet) permitted, from the left to right, in order to bring the barge and tug up into the tide in preparation for landing the barge. At about the time the barge was perpendicular to the dock, in its' swing around into the tide, the tanker called the Providence and said he was going astern and would back up to the north end of the dock (about 300 feet) to allow the barge to land. The Providence immediately responded with "I'm rounding-up, why don't you pull ahead." Although this "advice" was repeated, the tanker continued backing to the north end of the dock, either not hearing the call, or choosing to ignore it. In his final position the tanker was partially blocking the area in which the barge would have landed. The Providence could not continue the maneuver. In reducing power to abort the maneuver the strong winds and current nearly put her aground on Pralls Island.[26] Finally, the tanker was persuaded to move forward and clear the dock entirely and the Providence landed the barge and tied her up without further problems.

[26] See Chart Appendix B, p. 12B.

From the viewpoint of the Providence, the failure of the tanker mate to "correctly assess" the situation and move forward and clear of the dock placed the Providence in a situation that nearly caused a grounding. On the other hand, it must have seemed proper to the tanker to back up alongside the dock and out of the way of the tug and barge swinging across the channel towards her, as opposed to moving forward and across the bows. Whatever point of view is most reasonable, it seems clear that a "failure" of communications and perhaps an element of inexperience on the part of the tanker mate nearly resulted in an accident.

No "hard" documentation of these events exist. The description provided is based on the observer's perceptions of the events as they took place and conversations with the captain of the Providence, both during the incident and afterwards. The conclusions are also those of the observer and are in part based on the impressions of certain characteristics of the communication process as it occurs between vessels in confined waterways.

As in most human activities that require teamwork and cooperation, the amount of verbal communication required to permit everyone to perform satisfactorily is significantly reduced as the skill and experience of the team increases. Think for a moment about the newly organized basketball team. In the beginning the team captain may be required to verbally direct and instruct each team member in the execution of a play. As they gain experience together, individual direction is quickly replaced by having the captain call, or merely signal, by prearranged notation, the "play". With highly experienced teams even the act of calling a play often gives way to perceptions of the floor situation, e.g. an opposing player observed to be out of position can trigger a scoring play. Thus, as skill and experience increase so does, generally, the scphistication of the communication process, with its' natural accompaniments of brevity and conciseness.

So it is too with professionally crewed vessels working together frequently in the same "gaming" areas. A minimum of communications, or signals is usually sufficient to permit the professional to understand and anticipate the details of the most intricate maneuvers. Put another way there is an informal standing operating procedure (SOP) for the more common situations that arise. Part of the professionalism is knowing the SOP's for each reach, dock and pier under various conditions of wind and current; to know the vessels and their reputations for good or poor seamanship; to know what they do, where they work and even when. In an important communications sense a "community of understanding" and team play develops. A simple security call identifying a vessel, its' job, and its' destination often is sufficient to "communicate" a pattern of maneuvers to be performed at the destination point upon arrival. And even the arrival time can be estimated by the receiver of the communication, with reasonable accuracy, should there be a need to do so. As one pilot put it, "we always try to operate from the 'top rung' of the communications ladder at all times."

Does the communication process always work this way? Of course not. With the marine environment being as variable as it is, the SOP may often need to be altered to accommodate the situation. In these times the pilot may need to back down a few "rungs of the ladder" and spell out in some detail his intentions and problems. A pilot, for example, bringing a ship from sea that calls on the port frequently, will rarely feel the need to brief the master on the SOP maneuvers; consequently, their communications may be entirely mute on these points. However, should it be necessary to execute a non-standard maneuver, the pilot will almost invariably explain the situation and, if need be, the maneuver to the master, prior to its' execution. Similarly, if it's the master's first trip to the port the pilot will likely explain those SOP maneuvers that the master cannot be expected to understand.

Thus it appears that the extent of, or verbal detail included in a ship to ship communication, such as the one being discussed, is based in part on how standard the maneuver is, and in part on a judgment about the degree of professionalism that exists on the part of the receiving parties. Looked at in this way, the incident between the Providence and the harbor tanker suggests the tanker mate did not accurately perceive the situation and consequently maneuvered in a manner that led to a near accident. On the other hand, the captain of the Providence probably errored in his assumptions regarding the experience of the tanker mate. He likely could have persuaded him to move ahead rather than back, with a careful verbal detailing of the situation.

2. The Video/Audio Presentation

The presentation starts while the Providence is approaching the barge in preparation for the transfer from the Spartan. The camera is located in the wheelhouse at the right hand steering position.

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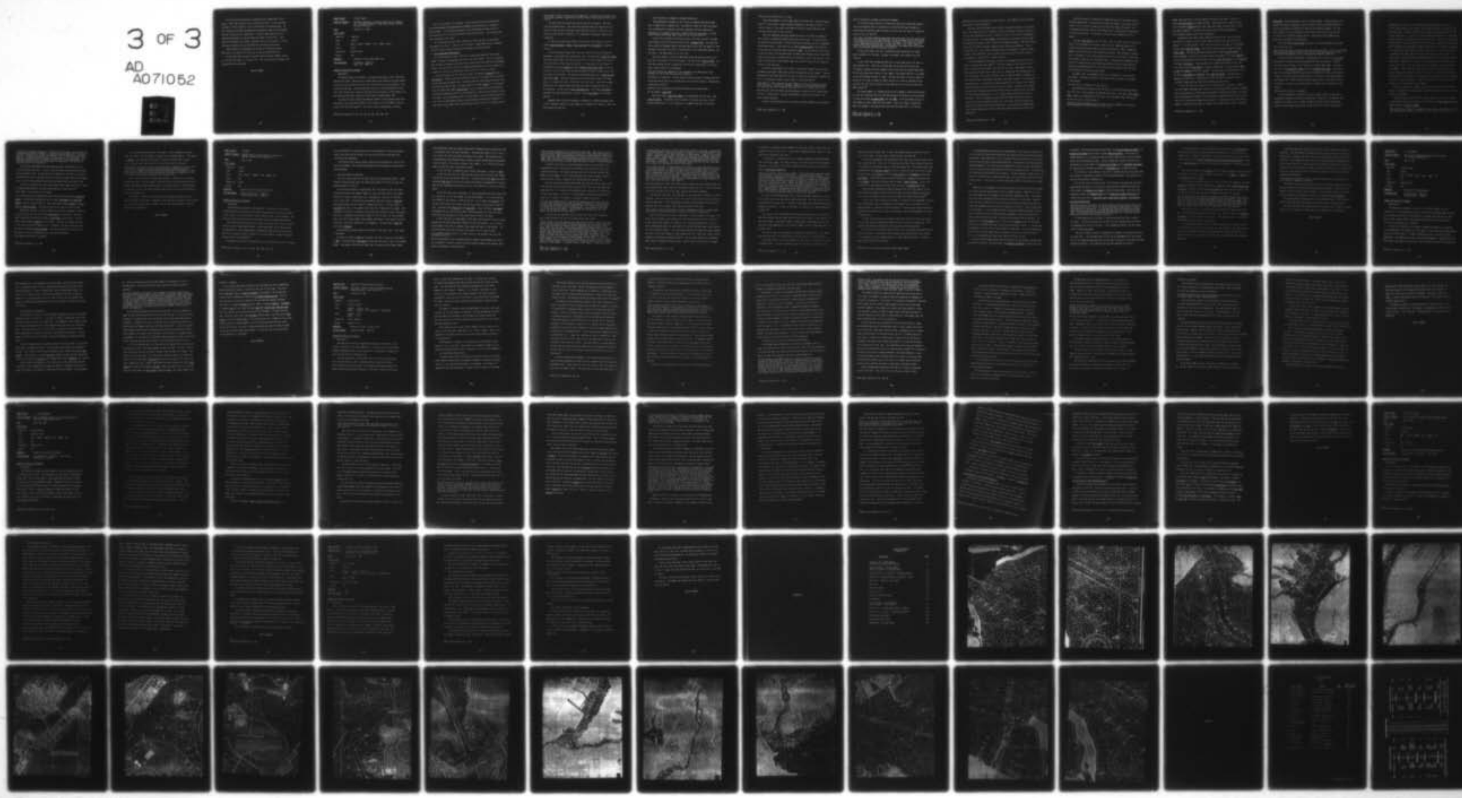

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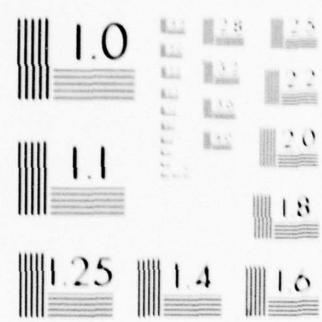


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

The first half of the tape is concerned with "making-up" to the barge. Since the situation, due to wind and current, is less than SOP, the mate is fairly explicit in his instructions to the deck hands. As one listens to the mate and observes the operation, most of the problems and their solutions are identified. It may be noted that the tug is making-up the barge "on the hip" and will push it stern first. This permits the barge to be berthed starboard side to, at Grasselli, without the need to remake the tug and barge for the docking operations.

The Providence is delayed at the Arthur Kill Railroad bridge. Being well into Arthur Kill the tide is now fair behind the tug.

As the tape ends the mate is talking with the harbor tanker tied up at the dock the barge is to be put into. Due to the onset of darkness the taping had to be concluded.

END OF TRANSIT

NAME OF SHIP: Olympic Games

ROUTE OF TRANSIT: Stapleton Anchorage to Chevron Terminal, Perth Amboy, N.J. via Ambrose Channel, Sandy Hook Channel, Raritan Bay and Arthur Kill

DATE: February 15, 1978

SHIP'S DATA:

Registry:	Liberian
Type:	Tanker
Size:	DWT: 32,380; LENGTH: 771'; BEAM: 105'9"
Draft:	35'9"
Propulsion:	Steam Turbine
Screws:	One

BOARDING: Boarded with the Sandy Hook Pilot

TUG ASSISTANCE: Providence - 1800 H.P.
Mobil Tug - 1800 H.P.

Summary of Points of Interest

1. Background

The Olympic Games was boarded in Stapleton Anchorage at about 1000 hours February 18, 1978. The pilot was already aboard and preparing to weigh anchor. Visibility was unlimited and winds were 8-10 knots out of the northwest. The tide was on the ebb. The ship had been laying to in the anchorage for a day and a half waiting for a berth at the Chevron Oil Terminal in Perth Amboy, N.J. and the high tide water required for her draft of approximately 36'.

The transit route followed the Ambrose Channel to the entrance buoys and then west to the Sandy Hook Channel, the entrance to the "southway" route to Arthur Kill and Perth Amboy.[27] The transit covers approximately 32 miles.

[27] See Charts Appendix B, pp. 4B, 3B, 2B, 16B, 15B, 14B, 13B.

Most of the transit is presented. Some minor editing was performed and on a few occasions the recording was stopped for short periods to conserve battery power. A long delay developed in the final phase of docking due to the presence of an oil pollution boom laying along the dock. The presentation was concluded at this point.

The recordings provide useful information about the aids to navigation throughout the transit. One aid, the "4" buoy in Sandy Hook Channel, appeared to be off station and the finding was reported to the Coast Guard.

2. The Video/Audio Presentation

As the presentation starts, the ship is dead slow ahead with hard right rudder, leaving the anchorage and turning into the channel. The pilot observes that the ebb tide against the port bow is setting the ship towards the Verrazano Bridge. He can observe the set by watching the motion of the ship relative to a couple of objects on the Brooklyn shore that he is using as a range.

Part way through the turn the pilot orders the engines stopped and then full astern. These actions are necessary because of the shoal area in the path of the ship near the shore line. He notes that the swing should continue since the ship will back to port. He then orders the rudder midship. A few seconds later he orders the rudder hard to port. He is watching the swing carefully, saying that sometimes ships will stop swinging as the ebb current tends to set the stern. He also observes that if it was later in the ebb tide and the ship was closer to the Brooklyn shore, the bow would be feeling the influence of the start of the flood current and the stern would still be in the ebb current.

(The volume of water flowing past the rudder will increase as the vessel picks up sternway, thereby increasing the effectiveness of the rudder and aiding the swing.)

The pilot asks the master how long he had been at anchor? The reply "one and one-half days". The pilot then observes that the "engines are not cold, but they are not hot either, that could be a factor." Here he is referring to the engine's capability for responding to emergency maneuvering situations.

As the ship becomes positioned directly across the channel, the pilot orders stop the engine, midship, hard starboard and full ahead to complete the turn.

As the Verrazano Bridge comes into view, the pilot calls the Maritime Exchange to report position, destination, etc. He then orders right 10° rudder, from hard right rudder, to slow his rate of turn in anticipation of lining up with the center of the bridge and channel. As the center of the bridge is approached, he orders midship and then steady on the course 165°, he says he is just a little to the right of where he wants to be so is steering 7° left to get out a little more. He then asks the helmsman what he is steering now? Then orders 160°. The pilot observes, as the ship passes under the bridge, that it is roughly 32 miles to the dock from this point. The pilot arranges passing with an inbound vessel and blows one whistle signaling the port to port passing. He then orders steer starboard 167°. And later half ahead to slow down for the inbound ship. He later orders slow ahead for the actual passing.

Somewhat later the pilot arranges a starboard to starboard passage with a small inbounder wishing to cross ahead to the Chapel Hill Channel. Again the pilot blows two whistles.

(The recording is stopped to conserve batteries.)

The presentation resumes at the "7" buoy as another passing arrangement is made with an inbound ship. The observer jokes with the pilot about the likelyhood of his getting a whistle response from the inbound ship.

(Ordinarily, in channels this wide in good visibility conditions, with VHF radio contact having been made, pilots do not use the whistle.)

As the ship approaches the entrance buoys, the pilot contacts a dredge and arranges a one whistle passing and orders starboard 130°. He notes that as he passes the Ambrose Channel entrance buoys he will put the wheel 5° right and make a slow easy turn over to the entrance to the Sandy Hook Channel, the "2A" buoy. The camera pans to the "2A" buoy.

The pilot speaks to the Pilot Boat New Jersey and advises that he will pass her to the west, into the "southway". He then orders right to 140°. He then asks the New Jersey to check with the office to determine if he can expect to meet traffic in the southway.

(The pilot office can determine if any movements with Sandy Hook pilots ordered will be in the area during his transit.)

The observer is negative. He then requests the New Jersey to contact Red Star Towing and advise that he is estimating arrival at Perth Amboy at 1345 and has a deep draft of 35'9".

(Red Star will be supplying the docking master and tug assistance.)

He then orders, steer 150°.

The pilot orders right 10° rudder as he approaches the "2A" buoy, then right 5° rudder. He observes that he wants to continue swinging a little. He then notes that it is all a question of judgment and feel of the ship;

"experience and repetition", he says.

The pilot comments on the strobe light on the "2A" buoy. He says that at night it is so bright it makes judging distance off the buoy difficult. It helps, he says, if you look at the base of the buoy rather than the light. The buoy can be seen off the port bow.

The pilot observes that even though the wind is off shore (northwest), the current is flooding and setting the ship to the right. He says he must not make the turn too soon. A short time later he begins the turn to approach the entrance buoys. After the turn he orders steady on 310°, then observes he must give a little more wheel and orders 309°. He says that we are setting to the red side at the entrance buoys (to Sandy Hook Channel) due to the flood tide, but as we get up around the "6" and "8" buoys, we will be setting to the black side and then as the channel opens up at the "9" buoy, we will again be setting to the red side.

As the ship approaches the "4" buoy in Sandy Hook Channel, he notes the helmsman using excess rudder and cautions him against so much "wheel". Shortly afterwards he concludes that the "4" buoy is 50-75 feet outside the channel and this is the apparent reason so much wheel is being required.[28]

(The channel is 800' wide and the ship appears to be in that quarter to the right of center. The ship is probably "smelling" the bank and bank effects are requiring the extra rudder to hold the ship in it's present position.)

He then calls the pilot boat and asks the mate to report the off station buoy to the U.S. Coast Guard. He asks the helmsman to advise him at once if he finds trouble steering.

A vessel in Raritan Bay calls to advise the Olympic Games of her presence

[28]See Chart Appendix B, p. 16B.

and to tentatively arrange a one whistle passage.

As the ship starts the turn into the west section of Sandy Hook Channel, the pilot observes that if you draw a line from the "9" buoy through the three buoys on the port side, the line will split the "15" and "11" buoys and point to the "14" buoy.[29]

(All charts from 1971-1978 designate what the pilot calls the "15" buoy as the "15A" buoy and the "11" as the "13" buoy. As he continues by giving distance to the buoys, he calls them the "13" and "15" buoys, still later as he talks with an approaching ship, he calls it the "15A" buoy. The "error" may be based on much older designations. Unfortunately, the camera was being worked on at the time and fails to provide a picture.)

As the pilot enters the turn, he observes that he watches the rudder angle indicator all the time. He says, you cannot trust anyone, not even yourself.

At the "15A" buoy he observes that this is one place you do not want to pass another ship. The point of Sandy Hook can be seen off the port bow. Throughout the area the pilot speaks of the tricky currents around Sandy Hook. He has also taken over control of the rudder in the sense that he is no longer giving the helmsman courses to steer. He then says that he likes to head towards the "17" buoy in order to "open" the turn a little so that when he approaches the "18" and "20" buoys, he can make the turn into Raritan Bay East Reach easier.[30]

The vessel ahead is a dredge and the pilot arranges a one whistle passing. As the pilot completes the turn into Raritan Bay, he returns to giving courses to steer and orders <u>starboard 285°</u> and then <u>286°</u>. As he approaches closer to the dredge, he again takes over the rudder. The pilot checks to determine where the dredge is working and notifies the pilot boat that it is working

[29]See Chart Appendix B, p. 16B.
[30]See Chart Appendix B, p. 15B.

Ward Point and will be there for about a month. (An example of one way pilots update their local knowledge.)

The pilot notes the course here is 286°, the gyro has about a 1° westerly error, the flood current is setting a little to the black side and the wind is fine on the starboard bow so he is going to steer a little high to compensate for these factors. He orders 289°. The observer mentions that the gyro does not provide an audible "click" as the ship's heading changes. The pilot agrees that the "clicking" provides a good cue that things are happening. He observes that it is particularly important when the helmsman is having trouble, he says, they often don't tell you and you have to notice the ship turning. (The camera is turned off for a short period.)

As the presentation continues, the ship is approaching the "9" and "10" buoys in Raritan Bay East Reach.[31] The pilot discusses the value of the "9" buoy in navigating the channel, particularly at night. When asked if every buoy should be lighted (every other buoy is lighted and the lighted buoys are 1.35 miles apart), the pilot indicates that it would be helpful, however, he adds that he feels comfortable with every other buoy lighted. The discussion continues and it is observed that having passed the "9" buoy, he has nothing marking the black side for several miles (2.7 miles). How does he navigate? He notes the red buoys that he uses and the stack on Sequine Point, he keeps it fine on the starboard bow. It is further observed that passing can be difficult. The pilot agrees and says that you really have to get over on the red side and the outbound vessel has a much more difficult problem because of the lack of aids on the black side. He says that now people don't like to pass between the "9" and "10" buoys because they do not look to be 600' apart.

[31]See Chart Appendix B, p. 14B.

The pilot says he is steering by judging distance off the buoys and by watching beacon "20". He says that he knows the beacon is not going to move since it is on a pile of rocks, but you never know about the buoys. He is also keeping the stack fine on the starboard bow. He adds that "things have to look a certain way. If they don't, then you know something is out of whack."

He orders half ahead at the "14" buoy. When the mate fails to record the order in the log book, he "insists" that he do so. When asked why, he insisted on having the mate record the order, he explains, that if something happens, the order and the time should be on record. He continues by saying that if he does not start slowing down here, he will not be able to slow the ship enough to make the turn at Sequine Point. Checking the tachometer reading at full ahead against the posted engine RPM and speed relationship and adding the estimated effects of the flood tide, he concludes that the ship was doing about 14 knots over the bottom.

As beacon "20" is approached, the pilot is asked why it sets outside the channel. He guesses because of the erosion that can occur on the edge of the channel.

(The recording is stopped for a few minutes.)

The presentation resumes at the "26" buoy in the Raritan Bay West Reach and the pilot is talking about the Sequine Point Bend. He orders rudder amidship, saying as we approach the "28" buoy, the ship should start falling off to the left, due to "bank effects".

(See the written presentation of the transit of the Stawanda for a more detailed explanation of bank effects at this turn.)

Rather than going left, the ship begins to swing to the right. The pilot orders left 15° rudder to steady the ship. Once the swing is started to the left, he orders midship and says that "she should keep the swing now, in fact she should speed up". The "28" buoy can be seen off the starboard bow. (The recording tape runs out and is replaced.)

He observes that under normal conditions the ship will turn by herself here and will require a lot of right rudder to stay on the red side of the channel. You start another turn at the "33" buoy so this adds to the problems. He then adds right 20° rudder. This slows the swing and he reduces to 10° right rudder. The swing continues slowing and he orders port 5° rudder. As swing increases in favor of the black side of the channel, he orders midships. As the ship approaches the "33" buoy, he orders port 10° rudder and then port 20° followed by hard port. The swing does not increase fast enough to suit the pilot and he orders half ahead to increase rudder power. He then orders ease to 10° and midship as the ship responds. To check the increasing rate of turn he orders slow ahead and midships, then right 10° rudder. He notes that it appears to be ebb tide. Checking the current effects on the buoys, he more confidently adds that the "ebb tide is making up early here."

As the "38" buoy can be seen off the starboard bow, reference is made to the Perth Amboy Anchorage just around the turn and the general confusion created for the lay person by all the buoys and markers off Ward Point.[32] The pilot notes that as he gets down further, he will move over towards the black side to "open the turn" to allow him to make the turn earlier. Believing a ship (the Marine Eagle) is coming out, he tries to contact it by radio several times. He orders

[32] See Chart Appendix B, p. 13B.

slow ahead. An Army Engineers' boat is crossing ahead. He then contacts the tugboat Providence, standing by at Perth Amboy to provide the docking master and tug assistance, to determine if she can see the Marine Eagle. The tugboat responds "no" and attempts to assist after the pilot says that he was in contact with the Marine Eagle earlier. Nothing positive regarding the position of the Eagle is established.

The pilot orders left to 224° saying he will move over towards the black side to open the turn.

(Notice that the pilot is again giving course heading orders. This may be because land references ahead of the ship are quite far away and, therefore, do not provide good information for the close steering control he desires.)

As the Ward Point Bend (East) is approached, the pilot orders half ahead and speaks of a vessel he can see approaching from the distance. He knows the vessel and the route it will follow out of South Amboy Reach. He starts the turn with starboard 5° rudder and then starboard 10° rudder. Reference is made to Great Beds Lighthouse and a beacon (unidentified) that can be used as a range in the event that the buoys are out of position. He further observes that beacon "52" is 200' outside the 600' channel and in low visibility this information is useful in using the radar to identify ships' positions in the channel.

(The tape runs out and is replaced.)

As the presentation continues, the pilot speaks further of the way he perceptually organizes the buoys to determine his position. He observes that outbound a straight line, or range, formed by the "49" and the "56" buoys leaves the unlighted nun buoy "54" to the left of the "line", assuming all the buoys are in position. He further adds that outbound in fog, or low visibility he looks for the "house" with a "gable" formed by the 49, 53, 54, 52 and 50 buoys. He also notes that the "shoal sticks out" between the "54" and the "56" buoys, "so you can't go buoy hopping between them." The dredge observed earlier is presumably working on this area. There are no buoys marking the black side of the channel from the "55" buoy, located at the western end of the Ward Point Secondary Channel (south side of Perth Amboy Anchorage) up to Woodbridge Creek above the Outerbridge Crossing. To maintain position in the Ward Point Bend (West) the pilot notes that he usually orders 10° right rudder and heads towards an apartment house and stack located near the Outerbridge. Keeping this range to his starboard beam and slightly open, he maintains position off the shoal waters to starboard and on his side of the channel. Still later as he continues in the turn, he identifies two stacks that he also uses as a *range* for the turn. He identifies the stacks and the edge of the channel for the benefit of the apprentice pilot accompanying him on a training transit. Later he notes that the stacks are opened up and he is in the middle of the channel.

The pilot resumes his attempts to identify the position of the Marine Eagle. The tugboat Providence appears approaching the port side to put the docking pilot aboard.

The pilot has carried 15° right rudder around the turn at slow ahead. As the Outerbridge Crossing comes into view ahead, he <u>eases rudder to right 10°</u> and engine to <u>dead slow ahead</u>.

(The docking pilot makes his appearance on the bridge. The camera is cut off while the observer attempts to establish rapport and secure permission to continue the recording operations. The docking pilot agrees to continuing the video/audio recordings. However, he remains uncertain about what is going on and why. Throughout the transit he volunteers little information and spends much of his time at conning position #4 on the port wing of the bridge. The observer, understanding this, leaves the audio mike in the wheelhouse in a continuing attempt to put the docking pilot at ease while still gaining an understanding of his maneuvers.)

As the ship approaches the Outerbridge Crossing, the docking pilot relieves the Sandy Hook Pilot. The two assisting tugs can be seen with the ship on the starboard side. The docking pilot, speaking to the master, says that they should put out at the dock two spring lines, two head lines and two breast lines, with the three forward lines going out before the three after lines.

As the ship steadies up after passing under the bridge, the pilot is using the Socony Reach Range on the shore dead ahead as a steering aid.[33]
(The range is not visible on the video.)
He is also watching the approaching vessel and just before passing stops the engine. As the bows approach passing, he orders hard aport and dead slow ahead to counter suction effects. After passing he orders midship, the port 20° and stop the engine. The Chevron dock can be seen off the port bow.

Smoke from the tugs' stacks indicates they have been ordered to position to hold the bows as the pilot orders half astern on the engine. Both tugs move into position as the pilot orders full astern on the engine. He then orders both tugboats hooked up (full ahead). The bows can be seen swinging to the right as the ship backs to port. Gradually the tugs check the swing and the pilot orders stop the engine. The bows then begin to swing left as the engine forces are stopped and the tugs continue pushing.
(The tape runs out and is replaced.)

[33]See Chart Appendix B, p. 13B.

As the presentation continues, the rudder is hard starboard and engine dead slow ahead. The Providence is moved to the starboard quarter. The engine is stopped. With the ebb tide running, the bows are moved into the dock first, allowing the tide to assist in bringing the stern to the dock.

(The pilot is on the port wing of the bridge and his commands to the tugs cannot be heard. However, the engine and helm orders can be heard and the orders to the forward tug can be inferred by observing it's quickwater. Likewise, orders to the stern tug can be inferred by noting the gradual shifting of the bows as she works to move the stern to the dock.)

An oil pollution boom is along side the dock. A radio call to the dock establishes that it will be moved. While waiting for the pollution boom to be moved, the observer notes the experience of the docking pilot: Working harbor for 34 years; pilot since 1952; averages 900 ships per year; during apprenticeship worked 1000 ships.

The camera is moved to the port wing of the bridge to observe the oil pollution booms and the dock. Eventually, the boom was moved and the tugs pushed the ship to the dock without incident. Due to poor picture quality, the presentation was concluded.

END OF TRANSIT

NAME OF SHIP: Stawanda

ROUTE OF TRANSIT: Ambrose Light, Atlantic Ocean to the Hess Oil Company Terminal, Port Reading, N.J.

DATE: May 3, 1977

SHIP'S DATA:

Registry: Greek

Type: Tanker

Size: DWT: 29,751; LENGTH: 560'; BEAM: 85'

Draft: 36'

Propulsion: Diesel

Screws: One

BOARDING: Ambrose Light with Sandy Hook Pilot

TUG ASSISTANCE: Margaret McAllister - 2000 H.P.
Victoria McAllister - 1600 H.P.

Summary of Points of Interest:

1. Background

The Stawanda was boarded by the observers in the vicinity of Ambrose Light where she was waiting for the flood tide and sufficient water to permit a safe transit via the "southway", behind Staten Island, to Port Reading. The video recording was started at the "2A" Buoy marking the Sandy Hook Channel.

The video presentation takes the viewer, with some minor editing, from the entrance buoys at Sandy Hook Channel, around Sandy Hook, across Raritan Bay to Sequine Point, down Redbank Reach, through the "buoy farm" off Wards Point and into the south entrance of Arthur Kill at Perth Amboy, through the Outerbridge and on to Port Reading.[34]

Throughout the transit the Sandy Hook pilot comments on the aids to naviga-

[34] See Charts Appendix B, pp. 1B, 16B, 15B, 14B, 13B, 12B.

tion, the effects of current and wind on the navigation of the ship and many other items that provide insight into the piloting tasks associated with transiting the "southway".

The docking pilot does an equally good job of explaining his use of the assisting tugboats, the problems associated with the approach, docking and related maneuvers.

2. The Audio/Video Presentation

The first scene shows the "2A" Buoy marking the Sandy Hook Channel. Immediately following these shots the camera pans ahead of the ship to show the entrance buoys "1" and "2".

As the entrance buoys are approached, the pilot explains that the tidal current sets across the channel (black to red), the buoys tend to get pushed over and it shoals on the black side. Consequently, he tries to stay well to his right hand. Following this explanation the pilot orders a right 10° and observes that the ship "doesn't" respond very well," he then orders a right 20° and notes a few seconds later that she is beginning to respond. The response is difficult to observe on the video due to lack of visual references. The pilot is observing the relative motion of the "2" buoy, off the starboard hand, the line of buoys ahead, and probably the change in the angle of the sea relative to the ship's heading for his judgments. He then orders right 10° and finally midships.

He questions the master about the accuracy of the ship's gyro. The answer is equivocal.

He orders a course of 307° and indicates the "basic course for the channel is 308°." He then orders half ahead slowing the ship down to see if she handles better. He suspects the ship was "smelling" the bottom at the higher speed.

Even though the tides are higher than normal he observes that he would not want to be earlier with this draft (36 feet). He notes that there is a 2' rise in the tide at this point and does not expect any trouble. The discussion continues and the pilot observes that 12 knots is about the maximum he could make with this draft. As a rule of thumb, a ship squats, i.e., sings at the stern, about one foot for each five knots of speed.

As the "4" buoy is abeam he orders another adjustment in course to 306°.

At the "6" buoy the pilot observes that we are still setting, even though "we are 20° low on the course right now." He then orders steer 305° and shortly afterward 304° left as he continues adjusting heading to compensate for the set. When he has compensated enough the ship will sail parallel to the line of buoys ahead.

As the "8" buoy, the turning buoy, is being approached the pilot notes that he is going to try 10° left rudder "to see what happens." He is anticipating the effects of the current in making the turn. As he orders the left 10°, the "9" buoy can be seen off the port bow and the current running hard on the "8" buoy. He then orders ease to 5° and steer 275°. Later he orders slow ahead. Throughout the turn the pilot provides information about the tide rip around Sandy Hook and the general piloting techniques he uses at the Hook.

As the "15A" buoy is approached a small boat can be seen off the port side, between the ship and Sandy Hook, heading for the ship channel. As it tries to cross ahead of the ship is suddenly loses power and stops in the channel. No serious problem exists for the ship since there is still room to pass.

(The unstable video picture is a normal signal to the operator that the tape is nearing the end.)

The pilot attempts to call the Coast Guard to report the breakdown and cannot get a response. Finally, he calls the pilot boat at Ambrose and requests they relay the message to the Coast Guard.

(The pilot was pleased that the incident was recorded. Small boats are a continuing source of anxiety and concern for pilots. Many small boat operators have difficulty judging the speed of oncoming ships and apparently have little appreciation for the risks they assume in crossing ship channels in front of them. They also seem to lack understanding about the very limited number of maneuvering options open to large, deep draft ships running in narrow channels.)

Following some editing, required because of poor picture quality, the presentation picks up the transit at the R"20" buoy marking the end of the Sandy Hook Channel. The beacons marking the start of the Raritan Bay East Reach are just ahead. In this area the Chapel Hill South Channel, coming in from the north (right), intersects the Raritan Bay East Channel.[35]

Part way across Raritan Bay South Reach the "10" buoy can be seen to the right and the "9" buoy can be seen to the left.[36] The pilot notes that the black buoy ("9") is a relatively new addition and a great aid in judging position in the reach. Prior to it's installation no black buoys existed between the "1" and the "19" buoys, a distance of about 5-1/5 miles.

(The section between the R"10" and the "20" beacon was edited out from the original tape to conserve the video equipment's batteries. The editing has not basically changed the scene, except the ship is a couple miles closer to Sequine Point, to be seen in the background. This section of the channel is Raritan Bay West Reach. As we resume the presentation, the "20" beacon can be seen to the right hand.)

In discussing the upcoming left turn the pilot notes that frequently, due to bank effects, the turn can be made using right rudder.

(Ships running in narrow channels with shoal water on one, or both sides, may respond to the water pressure differences acting on various parts of the vessel. Although several different pressure phenomena may be involved at any given time, they are most often grouped together and labeled "bank, or suction effects" by the shiphandler. Pilots usually anticipate these bank effects and measure their magnitude by observing the rudder angle indicator. As a ship starts "smelling the bank" she will try to move away into deeper water. The amount of rudder that must be held towards the shoal to keep the ship on a steady course is an indication of the distance off the shoal. In narrow, poorly marked channels, and/or under conditions of low visibility, the rudder angle indicator becomes a prime source of information about the ship's lateral position in the channel. If either right or left rudder is required to hold

[35] See Chart Appendix B, p. 15B.
[36] See Chart Appendix B, p. 14B.

a steady course, the ship is likely smelling the right or left bank, respectively. If no rudder angle is required, the ship is probably in or near the center of the channel. Ships do vary in their reactions to shoal waters. Some are very stable, clearly indicating the presence of a shoal by requiring extra rudder, towards the shoal, to hold a steady course; they may also be brought close to the shoal and held there if necessary. Others become unstable and perhaps totally unreliable under such circumstances. As they approach a shoal they may "go wild" and sheer out of control to the opposite side of the channel.

In this case the pilot is approaching a left hand turn, with shoal waters to his right hand and ahead. A stable, reliable ship can be brought close to the shoal on the right side of the channel and held close-in with good control. As the bank is approached the ship will signify by requiring extra rudder towards the bank to prevent her from moving away. Depending on the ship characteristics and the contour of the bank, at some point the rudder angle can be held constant and ship will follow the bank around the turn at approximately an equal distance off. Thus a left hand turn with right rudder.)

He also noted earlier that large ships must be mindful of their speed through the area because Lemon Creek comes out from behind Sequine Point.[37] A ship moving too fast pulls the water out of the creek leaving small boats grounded.

The observer asks about fog conditions in the area and its' affect on traffic movement. The pilot says that, "with less than 1/2 mile visibility you simply do not move back here." The conversation continues at some length, with the pilot agreeing that you can expect "fog" about 10 percent of the time.

(This figure of 10% was mentioned in studies conducted by the U. S. Coast Guard in planning for the Vessel Traffic Services for the Port of New York.)

Shortly afterward, the range at Red Bank is visible ahead of the vessel. He notes that the channel was widened after the range was built and he can go well to the right of the range if he needs to, e.g., to pass another ship. As he enters the Sequine Point turn the rudder is midships and the vessel starts swinging left from bank effects. Part way through the turn he adds left rudder because the swing is not fast enough to insure making the turn. The pilot likens a ship's movement to "watching a slow motion movie...you set your position for something that's going to happen 15 minutes later...not for what's here, that's no longer

[37]See Chart Appendix B, p. 13B.

of concern." He observes that outbound, he uses "20° rudder to start the turn (Sequine Point) all the time." It puts you in "good position", which, "is the whole key to operating back here."

As the turn is completed the ship is heading southwest in Red Bank Reach. The pilot orders 226°. Then orders port 5°. He later notes that the helmsman was going to steer the wrong course. When the ship returns to the heading he orders midship and steady now.

(Helm errors of this type are not unusual. Pilots habitually watch the rudder indicator and/or the way the ship swings in response to heading orders. In this instance he noted the helm going the wrong way and took the steering control away from the helmsman, i.e., once the ship was returned to the desired heading, he simply ordered the helmsman to steady up, rather than provide him with a course heading to steer. Notice how subtle the pilot was in correcting the error. Most pilots are careful not to publicly embarrass the helmsman, since this frequently leads to further confusion and more errors. If a helmsman is judged totally incompetent, pilots may ask that he be replaced, or give only rudder commands, thereby effectively taking over the steering job themselves. During the study both types of actions were observed.)

As the ship approaches Wards Point, several channels converge in a relatively small area, with each being marked with buoys. This has given rise to the nickname, "the buoy farm". The pilot talks about the area and the piloting problems it presents. A chart of the area is a useful aid in understanding his comments.[38]

As the ship turns around Wards Point and enters Arthur Kill, the pilot establishes contact with the tugs that will assist the vessel in the docking. He notes that there is good water almost to the Staten Island shore and that he uses two of the smokestacks in the area as ranges, observing them opening up as he moves north.

The tug is seen coming alongside to board the docking pilot. The second assisting tug can be seen taking her escort position on the starboard bow.

The pilot advises the docking master that the ship is drawing 36 feet and is handling well. The docking master takes the conn almost immediately and

[38] See Chart Appendix B, p. 13B.

advises the ship's master that he wants the forward and after spring lines out first at the dock. He then checks communications with the tugs.

As the ship approaches the Outerbridge, both tugs, one on either side of the bows, have lines up to the ship. The docking pilot notes that because he has had to slow down for the barge tied up to the dock ahead, he is not getting sufficient response from the hard port rudder to start his swing for the turn to the bridge. He then orders the Victoria (left bow) half astern and the Margaret (right bow) half ahead. As the swing starts he orders both tugs to stop and the ship's engine stopped. The swing continues and he orders, rudder midships. As he lines up with the bridge opening, he stops the swing with a starboard 10° order.

After passing through the bridge he observes that his next concern is the ship at the dock ahead, he does not want to pass too fast because he might part its' lines, and that he has his eye on the range just above Smiths Creek.[39]

A call from a ship undocking at Linden, in response to the Stawanda's security call, establishes that the Stawanda's pilot expects to be at the dock in Port Reading ahead of a potential passing situation. He also passes along information regarding a northbound ship, that he knows about, that the southbounder will meet on the way out.

As the original tape ends (unstable video) the pilot is pointing out a buoy off the Hess dock near Woodbridge Creek that sets on top of a large rock. This creates some special problems when docking there, which he describes.

The pilot notes the strong flood current still running and the height of the tide on the docks. He explains that although pilots would prefer less current, it is necessary to bring loaded tankers in, under these conditions, in order to have sufficient water for docking.

[39] The pilot is referring to the Port Secony Reach Range.

As he approaches the dock he asks the Margaret if she can get a second line up to the ship to prevent the flood tide from pushing her out of position during the docking. When the answer is no, he advises her to be careful to try to maintain her position during the docking maneuvers. He explains that duirng docking, when the headway is off the ship and he temporarily stops the tug, the flood current will spin the tug around and out of her best working position. A second line up to the ship would prevent this situation. He then proceeds to take some of the way off, using the ship's engine and the tugs, all going astern under his various control orders. From time to time the camera pans abeam to show the ship's headway.

When most of the headway is off the ship, the pilot has the Victoria release her line on the port bow and move to the starboard quarter. When she is in position he orders her full ahead to push the stern towards the dock. He explains that if he was stemming the tide, he could go directly into the dock. However, since the tide is behind him he must position the ship to allow the current to strike the starboard side of the ship, thereby utilizing it's force to help push him to the dock. In his present position, bows angled towards the dock, the current is striking the port quarter and has a tendency to push the stern to the right, which could turn him 180°, bringing the starboard side to the dock. He observes, as the full ahead order is given to the Victoria, that if she cannot push the stern towards the dock, he can do three things to help: 1) He can back the Margaret, which will pull the bow away from the dock. 2) He can come ahead on the ship, with the rudder hard to starboard, which will swing the stern to port. 3) He can back the ship, which swings the stern to port.

As the Victoria pushes ahead, the stern begins to move towards the dock and the bows off the dock. He then orders the Margaret one ahead to check the swing of the bow. The swing continues and he orders the Victoria dead slow ahead, the Margaret full ahead and the ship's engine dead slow astern. The Victoria is slowed because he is now backing the ship, which backs to port, providing additional twisting towards the dock. Having checked the swing of the bow to his satisfaction, he now orders the Victoria full ahead and the Margaret slow ahead. As the bow swing increases he orders the Margaret full to check the swing.

At this point in the maneuver the stern is towards the dock far enough that the current is beginning to bounce off the starboard quarter, the objective of the last few minutes of maneuvering.

With forces from the tidal current, the Victoria full ahead and the ship's engine dead slow astern, all working to push the stern towards the dock, the pilot orders the Margaret full ahead to check the bow swing. With the swing stopped he orders the Margaret half then to dead slow as easy as you can and finally he orders her to stop with just a touch once in awhile, so you don't get bent around there.

(The latter part of the order, of course, refers to the fact that the stern of the tug, with only one line up to the ship and dead in the water, will move in the direction of the current. In this case she will twist parallel with the ship and not be available to take immediate and effective action when called upon. The judicious use of her engine can help keep her in position without exerting significant side forces on the ship.)

As the camera pans to the dock it can be seen that the ship is dead in the water. The pilot observes that he has the ship's engine dead slow astern to compensate for the fair current. If he stopped the engine, the ship would start to move ahead again.

The vessel spoken to earlier (undocking at Linden) is just making the turn at Tufts Point. As the camera pans to pick up the downbound ship, the orange hull of the LNG Barge Massachusetts can be seen at the dock of the Rossville LNG Receiving Terminal. This terminal has not been approved for service.

As the ship begins to pick up stern way the pilot orders stop the engine and observes that he must watch carefully because she will start picking up headway again. Because the Margaret is now out of position, due to the current forces, he orders her dead slow ahead as easy as you can and get head on. Then it is dead slow astern for the ship's engine to prevent her from gathering headway.

The pilot now orders the Victoria from full ahead to half as the camera pans for another view of the vessel rounding Tufts Point. The engine is stopped and the Victoria ordered to slow.

As the pilot once again explains his stern in the first maneuver, he orders Victoria to half and shortly afterwards to slow and finally, dead slow as easy as you can. He then orders rudder hard a'port and adds that he did that "just in case they (tugs) need some help in keeping the stern off" the dock.

(As the stern of the ship moves to the dock, care must be exercised to insure that it does not hit the dock with enough force to cause damage. The pilot expects to use the tugs to check the advance towards the dock, as needed. The hard port rudder is an "insurance policy" in the event the tugs cannot check the ship sufficiently. With the rudder hard over and the engine half or full ahead for a brief time the ship can, if necessary, check the advance.)

The objective now is to position the ship parallel to the dock and push her in close enough to get the spring lines out. Thus, he orders the Margaret one ahead to bring the bows into position. (The unstable video is a signal to the operator that the tape is running out.)

As the new tape starts the ship is nearly parallel with the dock and the pilot continues working the tugs to push her into the dock. The ship's engine is worked, as needed, to maintain the ship dead over the ground and later to move fore and aft, as required, to position her to receive the cargo handling equipment.

The pilot notes that the difficulty with his job is that every docking is different. You must always think about the type of tugs you have, how strong the current is running, the wind, the type of ship and of course every berth is different. With respect to this berth, the pilot has observed throughout that the pollution control oil booms, used to put around the vessel after docking to contain minor spills, were not properly stowed for docking a ship. Consequently, there was a risk that the after one could be sucked into the screw and become wrapped around the shaft.

(These booms are required in certain areas around New Jersey and New York by city, county or township ordinances.)

With the spring lines on the dock the pilot now becomes concerned with his position relative to the dockside cargo handling equipment. The dock superintendent advises he must go astern 30 feet. This requires slacking the forward spring and taking in the after spring with the vessel moving slow astern.

The camera pans for another shot of the southbound vessel. The proposed Staten Island, LNG terminal storage tanks can be seen in the background.

The observer notes that the engine order telegraph does not have an audible signal on it to allow the pilot to easily get feedback on its' operation.

END OF TRANSIT

NAME OF SHIP: S.S. Pasadena

ROUTE OF TRANSIT: North of the Outerbridge Crossing to the Shell Oil Terminal, Sewaren, N.J.

DATE: May 2, 1977

SHIP'S DATA:

Registry:	United States
Type:	Tanker
Size:	DWT: 27,038; Length: 623'; Beam: 74'
Draft:	34'
Propulsion:	Steam turbine
Screws:	One

BOARDING: Boarded with Docking Master

TUG ASSISTANCE: Cynthia Moran - 1750 H.P.
Elizabeth Moran - 4200 H.P.

Summary of Points of Interest:

1. Background

The Pasadena was boarded in Arthur Kill, off Perth Amboy, with the docking pilot. The presentation starts just north of the Outerbridge Crossing and continues with one brief interruption, to change recording tape, to the dock at Shell Sewaren.[40] The tide changed during the transit from the end of the flood to the beginning of the ebb.

It may be of interest to the viewer to compare the tapes of the docking of the Stawanda at Port Reading and this docking. Both are deeply loaded tankers going into similar docks. A primary difference exists in the tidal current conditions. The Stawanda has a fair tide and the Pasadena is stemming the tide. The Pasadena approaches the dock bows first, putting the force of the current on

[40] See Chart Appendix B, p. 13B.

the starboard bow. The Stawanda on the other hand, with the current behind her, is maneuvered stern in first, putting the force of the current on the starboard quarter. In both instances the ships are maneuvered, stem in, or stern in, in a manner first, to minimize the amount of current flowing between the ship and the dock, which will tend to twist the ship around, and second, to take maximum advantage of the current forces in bringing the ships to the dock.

2. The Video/Audio Presentation

The presentation starts with the Pasadena located just north of the Outerbridge Crossing in Arthur Kill. The vessel is deeply loaded (34') and is beginning to stem the first of the ebb tide. The tugboats, Cynthia Moran on the port bow and Elizabeth Moran on the starboard bow, have lines up to the main deck. The docking pilot is at the conn and is steering on the Port Socony Reach range markers located on the shore, dead ahead of the vessel. The can buoy visible to the port side marks a large rock between the channel and the docks.

The Shell Sewaren dock lays about one point off the port bow. The Cynthia (port bow) is ordered to drop her line and take a position on the starboard quarter. The pilot has been reducing headway and has ordered the engine slow astern. The Elizabeth is ordered one easy, meaning to push the bows toward the dock at low speed, then one bell (half ahead) and finally hooked up (full ahead).

At this point the camera was off briefly while a new recording tape was installed. As the presentation resumes the engine is stopped and the ship is dead in the water, the Cynthia is ahead easy and the Elizabeth is ahead hooked up. The pilot observes he has his most powerful tug (4200 H.P.) on the starboard bow, since he can help his after tug with the wheel (screw) if necessary.

(As noted elsewhere, as a vessel loses headway, the amount of control the pilot can exert over the bows, using the ship's engine and rudder, diminishes. Therefore, it is common practice to place the more powerful tug forward when it can be anticipated that large forces may be required to control the bows. If such a situation is not expected, the docking master may put his own tug on the bows since it will be the last tug to leave the ship. This latter arrangement permits the assisting tug to go on to another job once the after spring lines are out. The docking pilot usually remains on the ship until mooring is completed.)

As the docking maneuver continues the pilot says, "I've got 4200 horse power on that tug there and she still can't hold the bow." At this point the Elizabeth is hooked up and still barely able to hold the bows from going to starboard. Although still early in the ebb tide, strong current forces are bouncing off the Sewaren shore and striking the port bow. The pilot counters these forces by having both tugs working to push the ship towards the dock. The Elizabeth, with nearly twice the power of the Cynthia, is gradually gaining headway. As the bows are increasingly angled towards the dock, the current forces are being shifted from the port to the starboard side of the ship.

It will be noticed that at no time during the docking does the pilot permit more than a 15^{o} - 20^{o} angle between the bows and dock. He says, "with the tide running you have to be careful you don't get too much of an angle. The current will set you over." As the Cynthia needs assistance in bringing the stern in, the pilot orders slow astern on the ship's engine, this twists the stern towards the dock. Rather than gather too much sternway the pilot stops engine and orders the Elizabeth two easy, meaning to back, or go off the dock easy; he then orders her half astern, slow and stop as the angle between ship and dock is reduced.

As the vessel comes nearly parallel with the dock the ship is gathering some sternway and the bow is starting to fall off to the right. The pilot orders left 20^{o} rudder and dead slow ahead on the engine. As the bow continues to go to starboard he orders the Elizabeth ahead one easy. This returns the ship to a position parallel with the dock and reduces sternway. The Cynthia is ordered one easy and the rudder is ordered midship. Elizabeth is ordered stop and the rudder ordered right 10^{o}; engine stop; Cynthia stop. The pilot now has the ship moving towards the "landing". To check the movement, the pilot orders both tugs two easy (astern easy), then the Cynthia half astern, and the Elizabeth stop. At this point the ship is dead over the ground and both tugs are ordered ahead to put her on the dock and hold her there. Using ship's engine, the ship is then positioned fore and aft along the dock to line up the cargo handling equipment. The spring lines are put out and the presentation is concluded.

END OF TRANSIT

NAME OF SHIP: Tugboat Providence, Barge Stonybrook

ROUTE OF TRANSIT: Port Mobil, Staten Island to Glenwood Landing, Hampstead Harbor, Long Island, N. Y.

DATE: February 28, 1978

SHIP'S DATA:

Registry:	United States
Type:	Tugboat & Barge
Size:	Tugboat - Length: 105' Barge - Length: 275'; Capacity: 18,000 bbls.
Draft:	Tugboat - 12'6" Barge - 12'+
Propulsion:	Diesel 1800 H.P.
Screws:	Tugboat - one

BOARDING: Boarded Port Mobil (Arthur Kill)

TUG ASSISTANCE: Tugboat Chemung - 1800 H.P.

Summary of Points of Interest:

1. Background

The observers boarded the Tugboat Providence at Port Mobil, Staten Island in Arthur Kill at about 0800 hours. The destination was Glenwood Landing, Hampstead Harbor, Long Island, N.Y. The barge was loaded with fuel oil destined for residential use.

This was considered a "high water job" in that only at high water can a tug and barge, at their respective drafts, approach the pier. Since the transit from Port Mobil to Glenwood Landing takes about five hours, careful planning and execution is required to avoid arriving too early, or even more importantly, too late. In either case, the tug is delayed and becomes unavailable during that period to take on other jobs. The importance of this economic consideration to the towing company is self-evident. However, it is further illustrated in this transit by the presence of the Tugboat Chemung to be seen alongside the barge for that portion of the transit up the East River and through Hell Gate. The extra power permitted the Providence to make up some time lost earlier.

The camera is located inside the wheelhouse at the port side steering position for the transit to the dock. During the approach and docking the camera was located at the starboard side steering position. Both the captain and the mate preferred steering from the right side except when docking to port.

Only those portions of the transit judged to be of particular interest to the study were taped due to it's overall length. Much of the footage for the taped portions of the transit were further edited for this presentation.

Unfortunately, the audio is not always easily understood; consequently in such situations, conversations and comments judged to be of interest are summarized for their essentials in this running commentary.

2. The Video/Audio Presentation

The edited tape starts at Governors Island with views of two Coast Guard vessels observed while proceeding northward in Buttermilk Channel. The tug in view alongside the barge is the Chemung. The viewer will appreciate that the Providence is lashed into the "notch" of the barge.

The viewer unfamiliar with the area should know that Governors Island lies to our left hand. Some of the Brooklyn piers are ahead, or to our right hand. Lower Manhattan and the Battery is ahead and to our left hand, with the Staten Island and Governors Island Ferry Terminals clearly visible. The Brooklyn Bridge crossing the East River lies ahead.[41]

Proceeding north in Buttermilk Channel (east side of Governors Island) the captain of the Providence and the observers engage in a series of conversations triggered largely by what we are seeing and hearing (radio). The first involved certain aids to navigation used by pilots in maneuvering ships in the channel between the Battery and Governors Island when going to the Brooklyn piers, or the East River, from the southwest side of Governors Island: First, a Battery Tunnel ventilator located on the northern end of Governors Island, followed immediately by a building on the Brooklyn shore. These two prominent landmarks are used by many pilots as a range for starting the turn at the Battery. Once they are into the turn they then rely on the range lights fixed to Pier 2 Brooklyn, when they are visible. The qualification is added because at the time this tape was made an Egyptian ship was docked at the end of the pier and in front of the range, effectively blocking it from view (see below).

In discussing Buttermilk Channel it was observed that Governors Island provided an apparently natural traffic separation area for north and southbound ships. When asked why it was not used as such, the captain replies that he "doesn't know". He notes that he often uses Buttermilk to

[41]See Charts Appendix B, 4B, 5B.

avoid the Ferry Terminals, but many pilots prefer going around the Battery. (This may be due to the deeper water on the other side of Governors Island.)

The Egyptian ship, noted above, blocking the Battery range comes into camera view off the starboard bow. It can be observed also that it's position at the end of the pier blocks the vessel Aziz Bhatti docked starboard side to, behind the Egyptian ship's stern.

(This situation came into sharp focus for the captain and observers the following night when he was assigned to undock the Aziz Bhatti on the flood tide. Because the Egyptian overhung the dock in front of the Aziz by about 40 feet the captain refused to undock her until the Egyptian was moved forward to clear the end of the Aziz's dock.)

The captain is then asked his feelings about the Vessel Traffic Service scheduled to begin in New York this summer. The conversation elicited feelings of concern regarding: 1) The qualifications, knowledge and experience of the personnel manning the VTS, in that so much of the work in New York requires rather precise timing to catch the proper tides and water depths at various docks; 2) the perceived added responsibility burden placed on the pilot; and 3) the somewhat awkward position in which docking pilots who are also tug captains find themselves in the event of an accident. As the pilot, they are hired by and represent the ship, but nevertheless their primary work is for the towing company. If the tug itself is at fault or contributes to an accident, the pilot can feel a conflict of interest in testifying against the tug.

The hull of the Seawitch is visible in the old Brooklyn Navy Yard.

This is what remains of the ship that lost steering and rammed the Esso Brussels in Stapleton anchorage a few years ago.

The captain is asked if he considers the VHF radio "security calls" (identifying the vessel, it's position, immediate and/or ultimate destination and in the case of tugs what is being pushed or towed) system adequate for assessing traffic movements. He said that he thinks it works well, with the exception that it sometimes becomes overloaded with "chatter". He feels that the solution is lower powered radios that restrict channel 13 transmissions to no more than 5 miles. He felt that for most traffic movement information purposes the need is to know what is moving in your immediate area as opposed to hearing every movement in a 25 mile radius. This is followed by some clarifying conversation regarding radio equipment on board and the use of the "house" (company) channel for docking and undocking. The pilot notes that some companies do not have or use a house channel for these operations.

A security call is given at Poorhouse Flats Range.

As he heads towards Manhattan, he points out landmarks that are used as a range by most pilots transiting this area: The tall smokestack with the black and white top and the Chrysler Building. He notes that he would not make the swing this soon with a deep loaded ship.

(If one observes a chart[42] of the area it can be seen that a line drawn through the Poorhouse Flats range on the Brooklyn shore and extended across the river to Manhattan will pass nearly through the "tall stack" and the Chrysler Building. The line is not perfect, but it is close enough that most pilots use it when heading up river. The alternative is to go out on the bridge wing and use the Poorhouse Flats range behind you. All this is made important because the deep water from the Williamsburg Bridge north to the entrance of Newtown Creek is on the

[42] See Chart Appendix B, p. 5B.

Brooklyn shore. At Newtown Creek the deep water follows a diagonal across to the Manhattan shore and north along the west side of Roosevelt Island. Further, as the captain notes later, the northbound trip is usually the more critical because most ships northbound are loaded, while southbound, when one can easily see the range on the Brooklyn shore, the ship is light and water depth is not so critical.)

The captain yields the conversation regarding the Chrysler Building range to respond to a general question regarding the adequacy of the aids to navigation in the harbor. He responds that generally they are pretty good, but can think of some changes he would like to see made. He gives examples: The presence of second class buoys marking wrecks that everyone is aware of (Morris Canal) that could better be used to replace "matchstick size" buoys in areas (Astoria - Hell Gate) that are highly traveled under difficult conditions.

He then returns the conversation to the Chrysler Building range and observes that one of the problems there is that, neither the building, nor the tall stack have lights on them. Consequently, on a "smoky" night they are hard to find and one must look for a lighted Coca Cola sign (that is turned off at 2400 hours), slightly off to the north of the base of the stack, and estimate the position of stack and building from the position of the sign. The conversation continues and gradually settles on the potential value of a range on Wards Island[43] for navigating the reach running north between Roosevelt Island and Manhattan. Given a choice the captain says he would rather have lights on the stack and the Chrysler Building, because the reach is straight, permitting navigation by gyro courses, and there is good water from bank to bank.

Ahead the Queensboro Bridge and the 59th St. Tramway to Roosevelt Island can be seen. The land in the far distance is Wards Island.

[43] See Chart Appendix B, pp. 5B, 6B.

The captain speaks with the office regarding the tug Chemung and how far up the river she will accompany the Providence. The office responds, "through the Gate", meaning Hell Gate. Present position is just above the 59th St. Bridge.

The mate comes into the wheelhouse to relieve the watch at about 1145 hours. He immediately observes the situation and reacts by saying, "when I got up, I thought we were bucking the tide, we got fair tide, we better have if we're going to Glenwood Landing". The captain acknowledges the fair tide and explains that the swells are from a tug passed some minutes earlier. The mate then asks about the docking and how the barge handles. The captain briefs him further on the Chemung situation and advises, "keep him through the Gate" and when "you feel you don't need him, let him go." He adds that they should be there (Glenwood Landing) around 3:00. Some "bantering" follows with the mate saying 3:07. The captain comes back with,"what time will you have the first line out?" The mate: "2:45". The captain: "can we have an anchor pool on that, et al?" (Interestingly enough, the mate missed the ETA by only a couple of minutes.) To the right of the screen can be seen the Triborough Bridge crossing from Wards Island to Astoria, with the Hell Gate Railroad Bridge just beyond.

As the bridges come into better view the mate observes traffic westbound through the Hell Gate and contacts the vessel via channel 13 to arrange passing signals.

The mate observes, "there is not much play in this notch". Here he refers to the handling characteristics of the barge and the manner in which she is secured to the tug.

The mate says that the downbound vessel is in the way of where he would like to be. He says he would be steering for the point on the left hand side since the current pushes you to starboard. However, he notes that you must be cautious since there is an eddy just on the other side of the bridge and if you are so close that the bows get into the eddy and the current is on the port side, it can turn you around fast.

(As was pointed out elsewhere, see the transit of the S. S. Great Republic, the current is so strong in Hell Gate that pilots do not attempt to buck the full strength of the tide. They transit in fair or nominal tide and ideally try to be there one hour before predicted slack water.)

He notes that he has dropped his engine RPM's to reserve an extra "kick" in the event he needs one. If you get into trouble coming through the Gate, "hooked-up", there is no reserve and little you can do to save the situation. The tide sets the vessel into the rocks on the right side. He points out that although it appears we are going straight, if you look far ahead you can tell we are setting to the right.

A following vessel, having heard the previous communications of the Providence, requests information regarding traffic that might affect him. This type of bridge-to-bridge assistance is quite common.

The mate refers to the vibration from the wheel (screw). It was replaced the week before. The observer's comments about "touching down" last night were said in jest.

Having passed through Hell Gate the mate applies full power (hooked-up) to the Providence and requests the Chemung to hook-up also. As the assisting tug applies full power the smoke from it's stack is blinding for a moment.

The Providence calls the Toledo Sun to arrange a two whistle passing. Shortly afterward he requests additional rudder from the Chemung to lessen her tendency to push to starboard.

(To conserve battery power the video equipment was turned off until the Providence started to enter Hampstead Harbor.)

The presentation resumes as the Providence and barge Stonybrook are entering Hampstead Harbor, Long Island. The ice covering much of the harbor can be seen in the background. The mate has been asked to think-out-loud all the way in, if he can. His performance in this regard is about what can be expected the first time a person tries the technique.

The mate immediately starts discussing his concerns about his speed. He would like to reduce headway because the channel is very narrow and poorly marked. However, he notes that if he reduces speed too much he may lose time and needed water at the dock. He may also need the extra headway when he enters the ice ahead. He also says that the bays on Long Island get shallow quickly as you enter and as the "wheel" gets close to the bottom the barge can take a sheer. He then decides to slow her down a little anyway because you never know who may be tied up to one of the barges ahead. With this thought he issues a security call. He says that the good water is to the right and normally he would be about where the scows are moored.

As the mate remains silent, the observer attempting to stimulate him to talk, points out the right rudder the tug is carrying in order to maintain a straight course. The mate explains that is due to the hawsers being used to make up the barge in the notch. The stretch in the hawsers permit the tugs bows to move about in the notch. Since the tugs pushing forces are not exactly along the centerline of the barge, it is tending to go to starboard thereby requiring right rudder to keep her "head" straight. For a long trip, wire cables would be used to make the connection more rigid.

The mate then notes that it appears that the mooring buoy has been "dragged" towards the shore. He bases this on his position relative to the pier ahead. He says he is in good shape where he is now. He later speaks of a grounding he experienced in the area.

As the tug enters the ice the mate says he is on dead slow and moving right along. Here he is referencing the strength of the flood current.

As the scows are being passed the mate notes how he navigates in the area: As he passes a wooden pier on the right side, a couple hundred yards off, he keeps the beacon on the port side, there is good water up to the beacon with rock on the other side, and using the beacon and the left corner of the powerhouse in the distance as a range, he crosses the inlet. On the right a large sandspit sticks out towards the channel. He says if you get too close to that, the stern can "suck" in and the bow sheers off and you can become grounded across the channel. He later identifies the position of the sandspit as being dead ahead as he approaches the beacon to the port side.

The mate says he is going to take some more speed off since he is approaching a "bottle neck" and he must make a fair tide landing. He says from here on in he reduces way and just gives little "punches" ahead as he needs them to maintain steerage. The channel along the docks is barely wide enough to permit the passing of the barges that are normally berthed there.

The observer reminds the mate once again to think-out-loud. This time he does a credible job. The reader is encouraged to view and listen to this section. The "clicking" in the background is from the steering mechanism.

END OF TRANSIT

NAME OF SHIP: S.S. Great Republic

ROUTE OF TRANSIT: East of Bayonne Bridge to Howland Hook Container Terminal, Staten Island, N.Y.

DATE: April 28, 1977

SHIP'S DATA:

Registry:	United States
Type:	Container ship
Size:	DWT: 15,694; LENGTH: 601'; BEAM: 90'
Draft:	28'
Propulsion:	Steam turbine
Screws:	One

BOARDING: Boarded with the Docking Master

TUG ASSISTANCE: Elizabeth Moran - 4200 H.P. - Twin Screws
Marie Moran - 1750 H.P.

Summary of Points of Interest:

1. Background

The observers boarded the Great Republic with the docking pilot, off St. George, Staten Island. The presentation starts east of the Bayonne Bridge and is nearly continuous to the Howland Hook container terminal on the east side of Elizabethport Reach, immediately north of the Arthur Kill Railroad Bridge.[44] The current is flooding into New York throughout the transit. From St. George to Shooters Island, the current is fair with respect to the ship and from Shooters Island to the berth, the current is against the ship. Visibility is unlimited and winds are out of the northwest 18-20 knots.

[44]See Charts Appendix B, pp. 4B, 11B, 12B.

The pilot provides useful insights into the effects of the currents on ship-handling in this and other areas in the harbor, as well as important information sources he is making use of for maneuvering decisions.

2. The Video/Audio Presentation

The presentation starts in the Bergen Point East Reach of the Kill van Kull, with a view of the Bayonne Bridge in the background.[45] The assisting tugboat Elizabeth Moran has a line up to the ship on the starboard bow and the tugboat Marie Moran is coming into position to put a line up on the port bow. The docking pilot discusses the need for tugboat assistance through the Kills. He explains that although they are rarely called upon to provide assistance in this area, when they are needed they are like "life preservers", they are really needed. With lines fastened to the ship, they are available to push or pull the bows in any direction required. Should it become necessary to reduce the headway, or even stop the ship, they are in a position to do so quickly. Normally, they move along with the ship without, either assisting, or interfering with the maneuvering of the vessel.

The pilot observes that he would like to be going a little faster since they have gangs waiting for the ship at the dock. However, with the shipyard and the docks on the shoreline, speed through the Kills must be maintained below the level that can create damaging wake effects.

The pilot speaks of the tidal currents in the New York Harbor. He acknowledges that they are not as extreme as in some other places, but they nevertheless affect the way you must handle the ships. In fair

[45] See Chart Appendix B, p. 118.

current conditions, such as is being experienced in the first part of this transit, he says, as an example, you must give orders earlier than you would in slack water, or ebb current, conditions. He continues by pointing out that the tidal currents flow in and out of Newark Bay via both the Kill Van Kull and Arthur Kill. Thus, he notes, that a ship coming up the Arthur Kill, on the west side of Staten Island, and a ship coming west in the Kills can meet each other in the vicinity of Shooters Island and both can be experiencing fair current, i.e., with the current flowing with the forward movement of the ship. He further notes that the aids to navigation are coded in both the Kills and Arthur Kill as though Newark Bay is the port of call, i.e., proceeding west in the Kills the red aids are on the starboard side of the ship until you get beyond Shooters Island, then the black aids are on the starboard side.

The pilot is asked to comment about the obstructions to visibility created by the several cargo booms on the main deck. Generally, he says that they do create visibility problems, but this ship is not as bad as many he has been on.

As he passes the wake danger area, he orders half ahead, noting that the gangs are waiting on the dock and, "since time is money, we do the best we can" to deliver the vessel at the dockside in a minimum of time. He says, "there is nothing here that our wake, or suction, will bother until we get to the dredges ahead and then we will have to slow down again."

He orders the Marie to get a line up on the port side as he approaches the Bayonne Bridge. The Marie has been with the ship all along. He then notes that actually both tugs are on the forward part of the ship as opposed to the bows.

(The precise location of tugs, when they need to be secured to the vessel by lines, is dictated by the location of chocks, or bits on the vessel.)

When asked about his position in the center of the channel, he acknowledges that he is in the center, but is beginning to favor the north side because it is marked by three buoys. The south side has rock outcroppings, as does the north side, but has no buoys marking the rocks. When asked why not, the pilot says simply "you can't have buoys on everything." He observes that years ago the buoys on the north shore did not exist and only one lighthouse marked Bergen Point, now there are two beacons and the old lighthouse is gone, with the rocks that it once marked, removed to widen the point.

The pilot speaks of the silting problems in New York. Noting that the rivers bring silt into the channels all over the harbor. Pointing out the dredges ahead he explains that they are not improving the channel, rather their function is to maintain the existing channel by removing the silt.

As the ship passes under the Bayonne Bridge and approaches Shooters Island (dead ahead), the pilot speaks of the advantages of the radio in assisting traffic at this intersection in arranging safe passing situations. This is also the area where the currents are beginning to converge.

As he begins to make the turn around Shooters Island, he points out a beacon ahead of the ship (R "16") and a building on the Elizabeth-port shore on which the word SINGER is printed in large letters. He says by looking at the beacon and the building "you can tell how close you are to the edge of the channel." He explains that the beacon is in line with the letter G indicating he is on the south side of the channel. Had he been on the north side of the channel the beacon would have generally been in line with the water tower standing to the immediate left of the building. As the ship continues to swing to the right the beacon "moves" across the letters and is generally in line with the letter R. Observing the tide on a buoy to port, he says, that in a minute or two the bow will be in the current and the ship will start setting to starboard. He orders left 10° rudder and is told by the helmsman that the rudder is hard left. The pilot responds, leave her hard left and orders half speed ahead, sir. He explains that the bow is into the current he referred to earlier and it is setting the bow to starboard. That is why the ship is not responding to the hard left wheel with the engine on slow. With the engine half ahead she will start to answer the rudder.

(As noted elsewhere, the force obtained from a given rudder angle at low forward speeds is importantly dependent on the velocity of the screw current. Increasing the RPM's of the screw increases the velocity of the water flowing past the rudder and thereby the force it can exert. Since this force varies with the square of the velocity, doubling velocity quadruples the force.)

He says that going to half ahead here, for a few minutes, is undesirable if there are other ships around that can be adversely affected, but sometimes, he observes, you have no choice if the ship does not have sufficient rudder power at slow ahead to move her as needed. He adds that when the ship is large and deeply loaded it often takes time for the tugs to work themselves to the proper angle to exert the required force to move the ship around, even though they can usually help to back the ship and with the assistance of the ship's engine bring the vessel to a halt quickly.

The pilot then notes the tide on a buoy shown off to starboard and says it is running straight up north bay (Newark Bay). This is the approximate area where the current from Arthur Kill and the Kill Van Kull meet and often cause a ship to steer irradically.

The effects of the half ahead order given earlier are observed almost at once and the pilot has reduced the hard left rudder to <u>left 10°</u> and finally to <u>midship</u>. He then refers back to the beacon, the Singer building and the watertank and points out that the beacon is now in line with the watertank, which indicates that the ship has set to starboard across the channel to the north side. He continues the turn with <u>left 10°</u> rudder and observes that the forward half of the ship is entering the current that is fair against us, setting off the dike dead ahead, and the after half of the ship is still feeling the current going up into Newark Bay. All this tends to twist the ship to the left. He orders <u>midships</u> and the ship continues to swing left at an increasing rate as these latest current forces take over. He then orders <u>right 20°</u> to check the swing. When the swing is stopped he orders <u>midships</u> the rudder.

(In the background the audible "clicking" of the gyro compass can be heard. Notice how the frequency of the clicking correlates with the slowing of the swing of the bows, or heading. In low visibility conditions this can become an important cue to a shiphandler in estimating the rate of swing.)

With Shooters Island to our left hand, the pilot points out that years ago the "channel we are in now was not here". All the ships were taken around the south side of the island (South of Shooters Reach). That channel has not been maintained, he says, and now he would not try to take more than 22' through the channel. He thinks maybe thirty feet to the shipyard, but not beyond that.

As the ship continues in North of Shooters Island Reach, the pilot points out the Howland Hook container piers across the land from Port Ivory, which is just ahead on our port bow. He then explains how the current being experienced from Port Ivory to Howland Hook influence the manner in which the ship is maneuvered for docking at Howland Hook.

(Unfortunately not all of this explanation was recorded due to the need to replace the recording tape. The observer substitutes his recollection of what was said for the missing portion in this written explanation of the pilot's major points: The pilot observes that we are feeling the flood tide against the ship and will be docking port side to the dock, stemming the tide. In this case he can reduce headway to a safe level while still coming ahead enough on the engine to maintain steerageway. As he approaches the dock, he will check the headway with the tugs until he is approximately in the docking position. He can then let the port side tug take in it's line and move to the starboard quarter to assist the tug on the starboard bow in pushing the ship to the dock. Since the tide is against the ship, the ship's engine can be used ahead as required to maintain fore and aft position along the dock.)

When the tide is on the ebb, or fair behind him, the maneuvering is different. With fair tide you must proceed from Port Ivory to the docks as slowly as possible. Headway is only enough to keep the ship steering. *In the immediate vicinity* of the dock the pilot says he thinks in terms of two separate operations: The first is to remove all headway from the ship soon enough to allow the normal drift of the ship to put her into the approximate fore/aft position along the dock. The second operation involves having the tugs push the ship into the dock to get the lines out. He notes that if the ship has too much headway as it approaches the dock and it is necessary to go full astern for any extended time, things can get out of control. The ship backs to port, the bows swing to starboard and the ship can end up on the other side of the channel.

As the ship approaches the turn at Port Ivory, the pilot observes that with the flood against you this turn can provide quite a current effect for a long ship. Using a 751' ship with a 36' draft, the Pennsylvania Sun, which is following behind us as an example, he explains the problems: He says she must go as slow as she can. The current flowing up Arthur Kill banks off a dock just off the port bow out into the channel. As the ship's bows enter the turn, they come under the influence of this set of the current and tend to swing to starboard, while the stern remains under the influence of the original set of the current. As the ship continues to enter the turn, more and more of the ship, from fore to aft is affected by this new current set. Under it's influence, the ship can be hard over, left rudder, but continue moving in a straight line until the overall length of the ship is in the current, only then she will respond to the rudder and come around.

As the pilot finishes the above explanation he says to the observer, "See how they have all the booms up now?"

(Here he is referring to the cargo booms on the ship's main deck that are in the up position in anticipation of saving some time in starting the cargo unloading operations at dockside.)

The pilot goes on to observe that if we were on fair tide and had problems getting stopped at the dock, he would not have the option of going on through the railroad bridge immediately below the dock. He further observes that in Newark Bay you could probably put the ship on the bank if you encountered this situation, but here, he says, you really cannot because of the deep water from shore to shore.

To illustrate his earlier point about the current set on the Port Ivory turn, he observes that at left 10° rudder the ship is continuing to go straight ahead. He then orders left 20° and the ship begins to respond. He continues on this general point by observing that the same kinds of current set can be experienced in Hell Gate.[46] There the current is so strong that they "don't go through Hell Gate bucking the strength of the tide with a loaded tanker, we have fair tide or nominal tide. We try to be in Hell Gate one hour before the predicted time of slack water. If we are a few minutes late we still have slack water, the tide has been eased up pretty considerably and it's the best time to go through, but with fair tide, not bucking the tide." He observes that this is difficult for people to understand. He says that they think in terms of how you stop if you have to. But, he adds, you have less occasion to stop. The pilot then speaks of the tidal current effects that can be experienced in the channel between "Blackwells Island and

[46]See Charts Appendix B, pp. 5B, 6B.

Manhattan".[47] The currents can reach 4-3/4 knots and bucking the tide requires very careful steering. If you do not keep the ship's head exactly to the current, it can push you sideways faster than you are going ahead. Since it is not safe to get the ship going more than about 8 knots your headway over the ground is only about 3 knots. So it takes a long time to get through there. Even, he says, if you try to go faster, the tugs cannot keep up. So he concludes, we try to avoid bucking the full strength of the current there, also.

The pilot orders half ahead noting that with the current against us and the wheel over and slow ahead we were nearly coming to a stop. With just a "touch" of half ahead the ship responds and he orders the engine to slow ahead once again.

He then observes that one of the cargo cranes over the south berth, presumably where the ship is to be docked, is in a semi-down position. With the crane in this position, the ship cannot be berthed at that dock. Shortly afterwards the crane is raised to the full up position.

The camera is moved to the port bridge wing as the pilot continues to maneuver slowly into the berth. The *Marie* is ordered to recover her line and move to the starboard quarter.

Accurately judging the movements of a ship that is nearly dead in the water is difficult. The pilot explains how he does this. First, he is observing the relationship of a tower located down river in Bayway against the bridge structures just ahead of the ship. The relative movement of the tower against the bridge allows him to determine that he is moving slowly towards the dock, because of the wind effects on the starboard

[47] See Chart Appendix B, p. 5B. Pilot is referring to Welfare Island.

Manhattan":[47] The currents can reach 4-3/4 knots and bucking the tide requires very careful steering. If you do not keep the ship's head exactly to the current, it can push you sideways faster than you are going ahead. Since it is not safe to get the ship going more than about 8 knots your headway over the ground is only about 3 knots. So it takes a long time to get through there. Even, he says, if you try to go faster, the tugs cannot keep up. So he concludes, we try to avoid bucking the full strength of the current there, also.

The pilot orders half ahead noting that with the current against us and the wheel over and slow ahead we were nearly coming to a stop. With just a "touch" of half ahead the ship responds and he orders the engine to slow ahead once again.

He then observes that one of the cargo cranes over the south berth, presumably where the ship is to be docked, is in a semi-down position. With the crane in this position, the ship cannot be berthed at that dock. Shortly afterwards the crane is raised to the full up position.

The camera is moved to the port bridge wing as the pilot continues to maneuver slowly into the berth. The *Marie* is ordered to recover her line and move to the starboard quarter.

Accurately judging the movements of a ship that is nearly dead in the water is difficult. The pilot explains how he does this. First, he is observing the relationship of a tower located down river in Bayway against the bridge structures just ahead of the ship. The relative movement of the tower against the bridge allows him to determine that he is moving slowly towards the dock, because of the wind effects on the starboard

[47] See Chart Appendix B, p. 5B. Pilot is referring to Welfare Island.

side of the ship, even though the bows are pointed away from the dock and the headway is in that direction. Next he observes any two objects on the shore abeam of the ship, explaining that any two stationary objects can serve as a range. Using such a range abeam he can judge the headway. The trick, he says, is to use this combination of information provided by the ranges and overcome the undesirable movements at the right time. For example, the overhang of the ship's main deck is so great that to land at this angle is to risk striking the bits on the dock with the stern, or if the bow is in too much it can touch the cranes.

The pilot asks if anyone sees a "bridge sign." Here he is referring to a marker on the dock that tells him where the bridge of the ship should be positioned.

He establishes radio contact with a vessel northbound, approaching the Arthur Kill Railroad Bridge to inform him of his docking maneuvers and advise that he will be out of the way in a minute or two.

The pilot, judging that he is ready to bring the bows in towards the dock, orders the Elizabeth 1 bell (half ahead). The engine is ordered slow ahead and the Marie is advised that she should be all stopped. He then orders stop the engine and later backs slow astern to prevent further forward movement of the ship. The Elizabeth is maneuvered from half ahead to easy to half ahead. As the stern approaches the dock the ship is ordered hard left rudder and slow ahead. The Elizabeth is ordered, stop and back easy to prevent the bows from moving to the dock too fast. He continues to use the Elizabeth to control the approach of the bows to the dock. As the ship arrives parallel with the dock and in the approximately correct fore and aft position, he stops the engine, then half astern, then stop. At this point he learns that he should move the ship ahead for position and he orders slow ahead. Lines are out and he continues using the tugs to hold the ship to the dock and the ship's engine to position her fore and aft until the ship is in final position and lines are secured.

END OF TRANSIT

NAME OF SHIP: S.S. African Dawn

ROUTE OF TRANSIT: Pier 5 Brooklyn to Ambrose Light, Atlantic Ocean

DATE: May 5, 1977

SHIP'S DATA:

Registry:	United States
Type:	Freighter
Size:	DWT: 12,728; LENGTH: 572'; BEAM: 75'
Draft:	22'
Propulsion:	Steam Turbine
Screws:	One

BOARDING: Boarded with the Docking Master/Sandy Hook Pilot

TUG ASSISTANCE: Elizabeth Moran - 4200 H.P. - Twin Screw

Summary of Points of Interest:

1. Background:

This is a night transit. The camera is not sufficiently light sensitive to permit full appreciation of the visual scene. However, some feel for the differences between day and night pilotage problems can be sensed by watching the video and both the docking pilot and Sandy Hook pilot do excellent jobs in explaining their maneuvers.

The docking pilot provides a good explanation of his undocking maneuvers and the pace is impressive.

The Sandy Hook pilot provides good information about the aids to navigation he uses throughout the transit. A chart of the upper bay is helpful in following his commentary.[48]

[48] See Charts Appendix B, pp. 5B, 4B.

2. The Video/Audio Presentation

The presentation starts at 1900 hours with the undocking maneuver. All lines are clear of the dock and the ship's warning whistle can be heard in the background. The ship is port side to the berth in slack water and as she backs into the stream the flood tide, striking the starboard quarter, will tend to push her stern towards the dock. The major problem for this undocking is that once the vessel is moving into the flood current the pilot must prevent the current from setting the ship into the end of the pier. Briefly, he manages this by first having the tug, working on the starboard bow, "pinch" the bows to the dock, lifting the stern off the dock. With ship's engine full astern she quickly develops sternway. He then has the tug pull and later cross over to the port bow and push the bows off the dock. As he notes in his explanation of the maneuver, the ship's draft was only about 21 feet, had it been 28 feet, or so, he would have needed an additional tug working at the stream end of the dock to lift and hold the stern off the dock as he backed out.

After the docking pilot leaves the ship, a short conversation develops about a helicopter working over a small ship. Because the camera is not sufficiently light sensitive it is difficult to identify, as are most of the objects referred to during the transit. Nevertheless, the pilot provides useful information about landmarks and other aids to navigation he is using. First he points out the range, "green lights", behind us on the Brooklyn shore and observes that they are a little hard to use when going outbound in the channel[49] because you must go out on the wing of the bridge to see them. This takes your attention away, for a moment, on

[49]Butterworth Channel. See Chart Appendix B, p. 4B.

what is ahead. Thus he tends to use Robbins Reef Lighthouse and St. Peter's Church steeple on Staten Island. He acknowledges that they do not make a perfect range, but at least help him find his way through Buttermilk Channel until he can pick up the "30" buoy, the turning buoy out of Buttermilk Channel into the main channel. He also observes that a lighted pier just south of the Statue of Liberty is helpful in determining when you have cleared the shoal area that lies immediately south of Governors Island.

As a radio transmission is observed from a distant vessel the pilot notes that the override from distant vessels often interrupts the communications of vessels working together in an area and is one of the "obstacles to the job". He says you are mostly interested in communicating in 2-5 miles, sometimes up to ten miles, areas. The point is well illustrated a couple minutes later when a Staten Island Ferry attempts to call the ship for passing arrangements and is overridden by a distance transmission.

As the pilot starts his turn into the main channel he arranges a two whistle passing with the ferry boat and favors the red side of the channel, gradually opening the turn, after passing the ferry boat, to position on his side of the channel. He checks the ship's heading and compares it to the known channel heading and says he "has another 10^{o} to turn". At the same time he is watching a tug and tow approaching from about a half mile away. He observes that on very clear nights all the lights appear brighter and tend to blend both ship and shore, together. He says then you must rely heavily on the radar to avoid overlooking a ship's light. The video is "breaking up" signaling that the end of the original tape is approaching.

The pilot has been guarding channel 16 and hears a communication from a ship approaching Ambrose to board a pilot. The ship's ETA indicates he will arrive at the pilot station in one hour. The pilot concludes that he is likely to meet the ship there at about the same time.

The pilot points out the aids to navigation he is using. In our current position the "24" and "22" buoys, marking the left side of the channel, can be seen in the distance. The "24" buoy is the turn buoy just abeam of the Constable Hook Reach. He notes that the Robbins Reef Lighthouse, and it's fog signal in inclement weather, is also used as aids in making the turn. The light on top of the Marine Hospital on Staten Island is also visible (even on the video) and the pilot says he has been using it all the way down the main channel.

He observes that this is flood tide and the time tankers often get underway to move to the docks on the deep water (so he is extra cautious near anchorages).

An outbound ship, Atlantic Star, slows down to avoid potential problems with a ship turning in Gravesend Bay.[50] By radio communication the two pilots coordinate their speed to maintain their separation distance.

As the ship passes Stapleton anchorage the pilot checks for possible anchorages for inbound ships and discusses the characteristics of satisfactory anchorage "holes" and the information he is receiving by observing the radar. (This is routine practice among the Sandy Hook Pilots. They pass the information along as it is needed.)

The presentation is concluded due to the poor quality of video.

END OF TRANSIT

[50]See Chart Appendix B, p. 3B.

NAME OF SHIP: Tugboat Providence and Barge T-30

ROUTE OF SHIP: Flushing Creek to Metropolitan Dock
Great Neck, Long Island, New York

DATE: February 27, 1978

SHIP'S DATA:

Registry: United States

Type: Tugboat

Size: Tugboat - Length: 105 feet
Barge - Length: 275 feet; Capacity: 18,000 bbls.

Draft: Tug - 11 feet
Barge - 7 feet

Propulsion: Diesel H.P. 1800

Screws: One

BOARDING: N/A

TUG ASSISTANCE: None

Summary of Points of Interest:

1. Background

This job illustrates what the tug people generally refer to as "creek work". The Barge T-30, partially loaded with residential fuel, is picked up in Flushing Creek and moved to Great Neck, Long Island. The entire move is planned and executed on the flood tide to permit enough water at each dock to float the tugboat. The transit overall took about three hours. Although the Flushing Creek move appears on video to be the more difficult portion of the transit, it is not, according to the crew. The apparently wide open area at Great Neck is deceptive in the sense that the water shoals up against a very narrow and shallow channel practically all the way through the harbor to the docks.

A portion of Great Neck is filled with ice varying in thickness up to 10". No problems are encountered, however, even though other tugs in other sections of the harbor are experiencing difficulties.

For this presentation the camera is located at the left hand steering position in the wheelhouse of the Providence.

2. The Video/Audio Presentation

The edited presentation starts with the approach to the barge in Flushing Creek.[51] The captain estimates 8-10 feet of water under the keel and assumes the chief engineer has pumped ballast from the tug, raising draft to 11 feet. This apparent discrepancy in water depth is not resolved. The barge draft is about 7 feet. The barge is made up "on the hip" to be moved stern first. Both ends are shaped the same.

The Providence blows the whistle to alert the drawbridge operator.

The captain jokes about the fact that the dock to which he is taking the T-30 is even more difficult to get into than Flushing Creek. He characterizes it by saying that you must navigate in poor visibility by following the "duck blinds". "If a guy ever took his duck blind home, you would be lost."

The drawbridge starts to open amid a brief discussion of the marine right-of-way law. The captain says that they are not supposed to delay you more than five minutes, but it does not always work out that way.

The captain notes that the T-30 is about the widest barge that can be brought through the bridge "on the hip". Anything wider would require

[51] See Chart Appendix B, p. 10B.

the tug to push or tow the barge. In the case of the T-30 there isn't a notch, consequently rigging it for pushing, or towing is at least a 30 minute job.

The mate comes into the wheelhouse to relieve the watch. Notice the casual manner in which he obtains his briefing. A few key pieces of information from the captain, a look at the tide tables and the job "falls into place" for him.

(After leaving Flushing Creek the presentation is edited to save viewing time.)

The Providence is seen entering Great Neck. The mate indicates that he has slowed down because of the shoal water on either side of him. He also notes that a can buoy is out of position.

The mate says that of all the jobs they do he dislikes this Great Neck job the most. He says he always seems to have trouble on the way out, touching bottom and so on.

This ice is 10" or so thick and is slowing the tug down as it breaks through.

The captain comes back into the wheelhouse.

Later the mate says the engine just slowed down. He suspects the engineer slowed it because it was sucking up mud from the bottom. The captain asks if "she's pumped up", meaning ballast has been discharged. The mate says he told them to do it some time ago.

A radio call from the company dispatcher questions where the Providence is located. The dispatcher is probably in the process of planning another job.

As the Metropolitan dock is approached the pilot notes how little water there is at low tide. He adds that the channel is only as wide as the tug and barge combination. He identifies the dock just beyond the covered tennis courts.

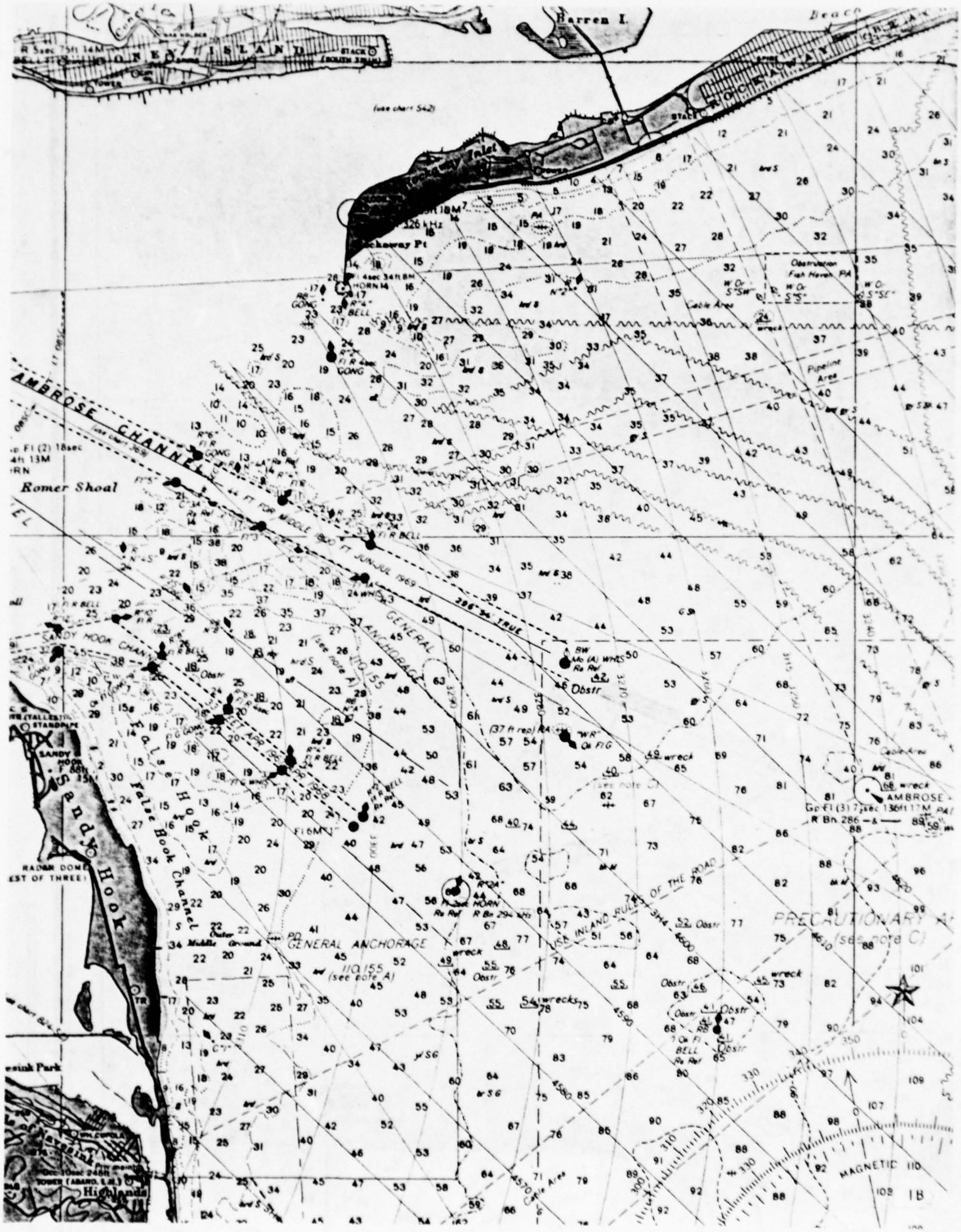
The mate says that most of the creeks around the area have high water one hour after high water at Hell Gate. He observes that you try to start in about two hours before high water so you can get in and back out again.

The mate instructs the deck hand, Frank, that he will have to land and back up. Throughout the docking the tug's wheel is turning up mud from the bottom.

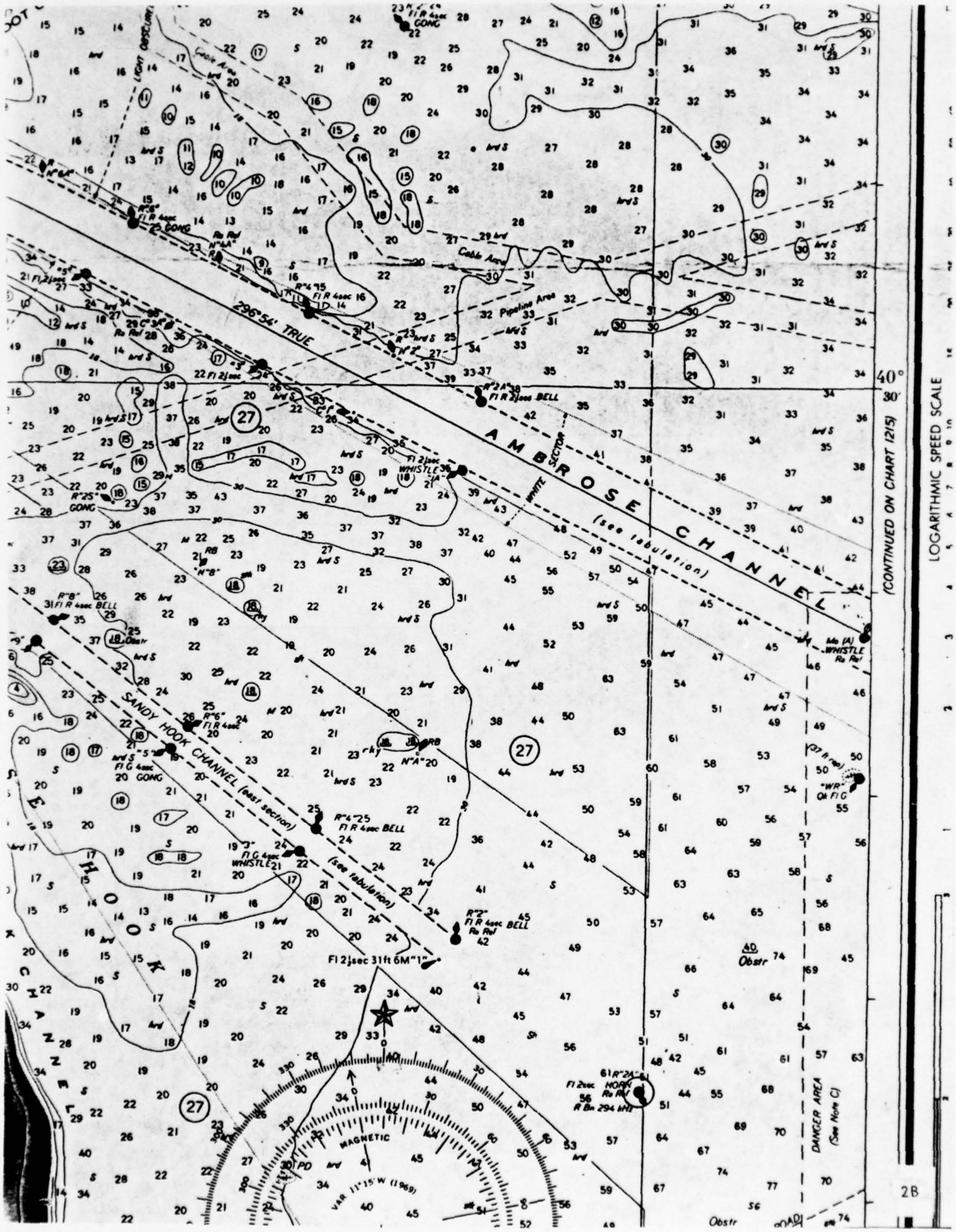
END OF TRANSIT

APPENDIX B

TABLE OF CONTENTS
APPENDIX B



Barren I.
ROCKAWAY
Rockaway Pt
(use chart 542)
Obstruction
Fish Haven PA
Cable Area
Pipeline Area
AMBROSE CHANNEL
Romer Shoal
45 FT FOR MIDDLE 1850 FT JUN-JUL 1969
286° 30' TRUE
GENERAL ANCHORAGE
110.155
(see note A)
SANDY HOOK CHANNEL
Sandy Hook
False Hook
False Hook Channel
RADAR DOME
Outer Middle Ground
GENERAL ANCHORAGE
110.155
(see note A)
USE INLAND RULES OF THE ROAD
PRECAUTIONARY A
(see note C)
AMBROSE
Obstr
wreck
wrecks
Highlands
MAGNETIC

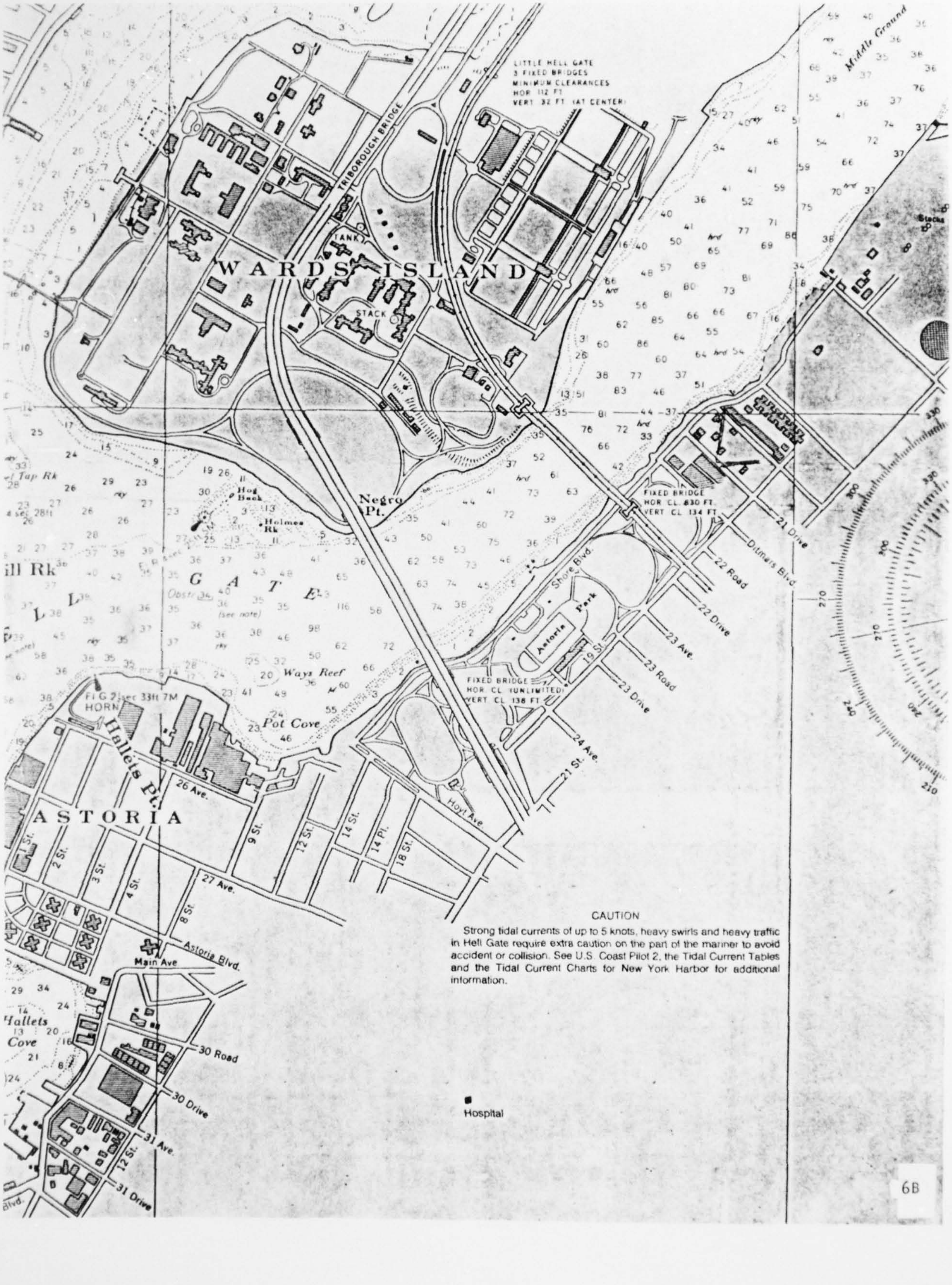

AMBROSE CHANNEL
(see tabulation)
296°54' TRUE
SANDY HOOK CHANNEL (east section)
(see tabulation)
SANDY HOOK
Cable Area
Pipeline Area
WHITE SECTOR
LIGHT OBSCURED
(CONTINUED ON CHART (215))
LOGARITHMIC SPEED SCALE
DANGER AREA (See Note C)
40°
30'
MAGNETIC
VAR 11°15'W (1969)
Fl 2sec 31ft 6M "1"
Fl 2sec HORN Ra Ref R Bn 294 kHz
Fl R 4sec BELL
Fl G 4sec WHISTLE
Mo (A) WHISTLE Ra Ref
Obstr

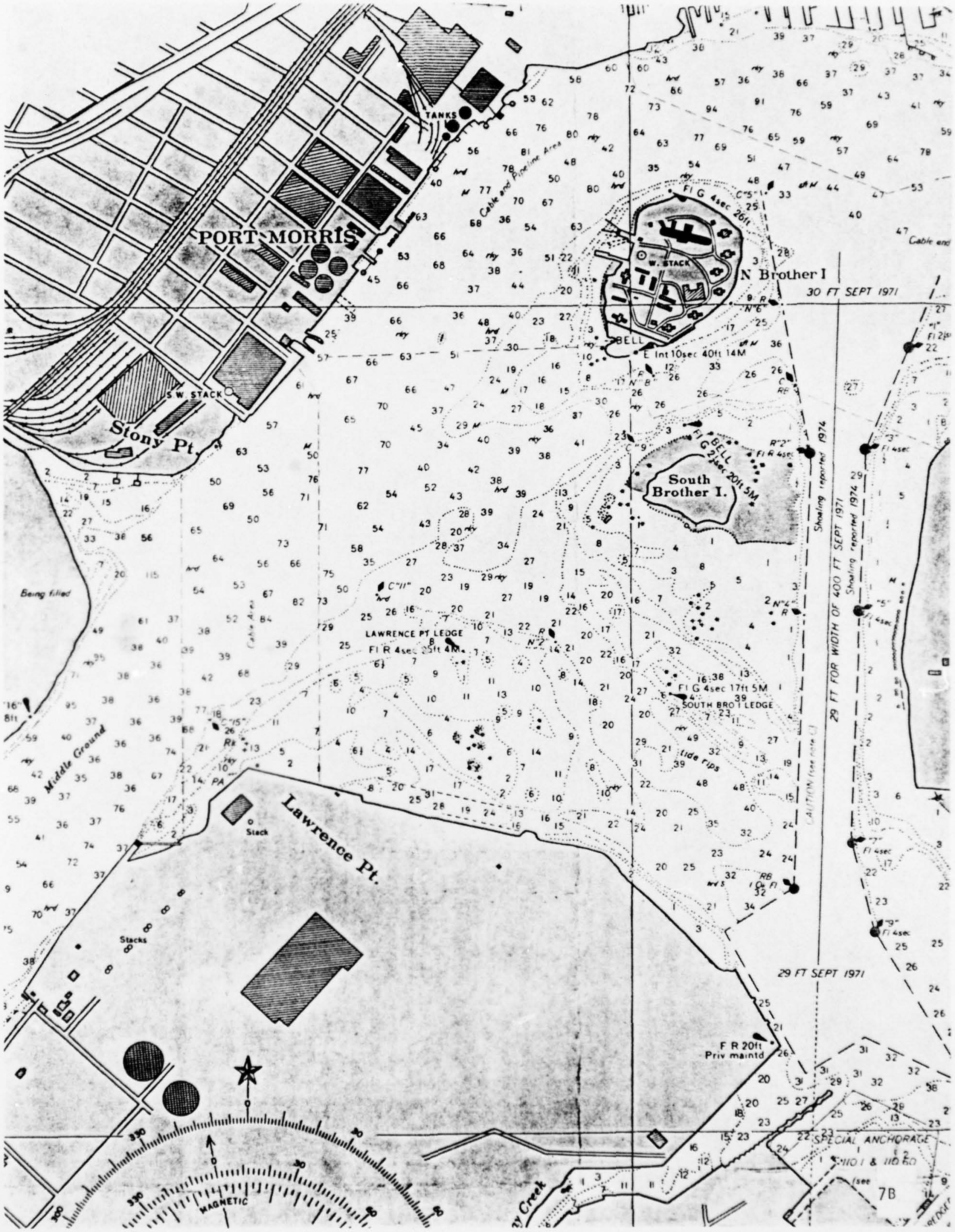
2B

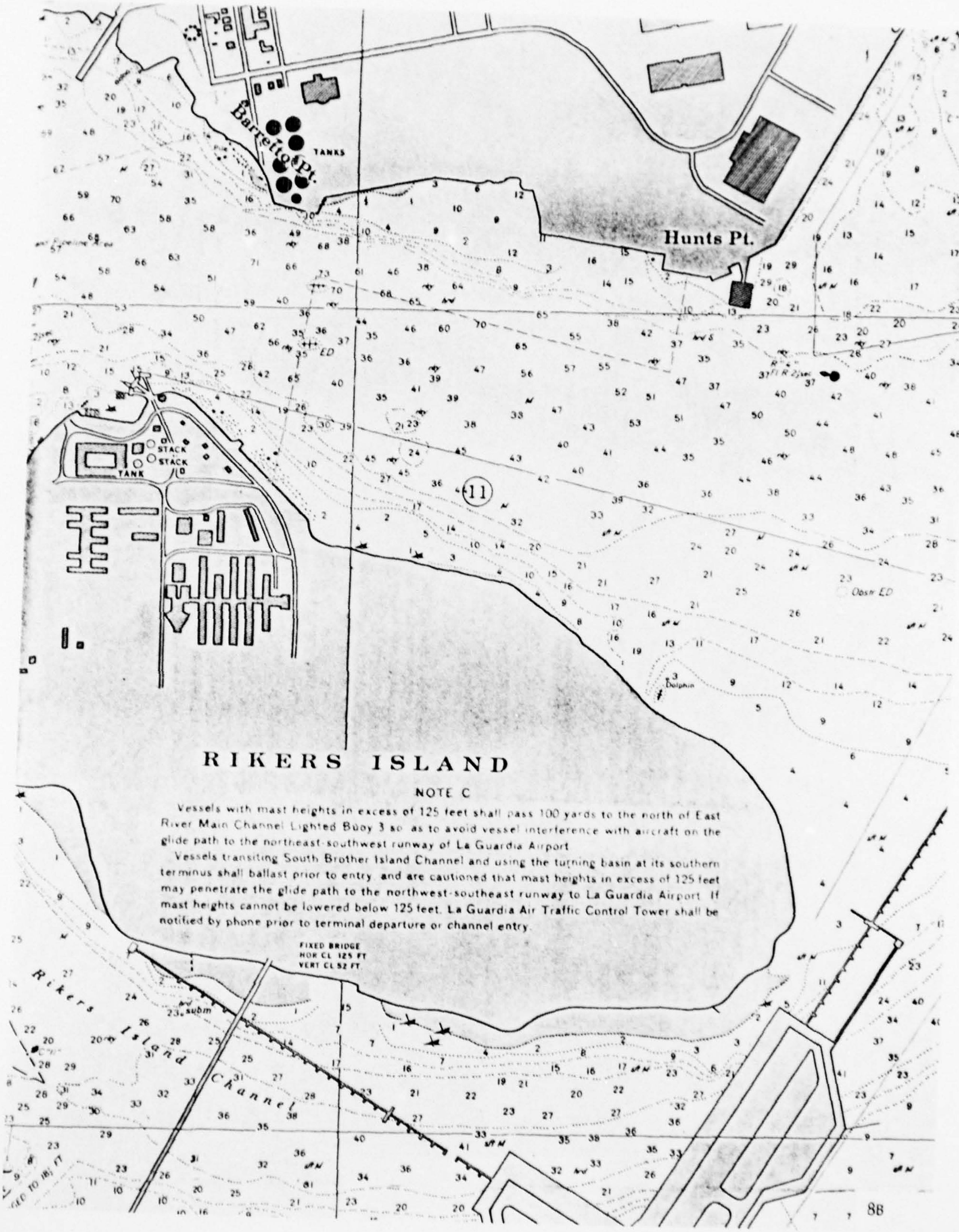

Grasmere
Ft. Wadsworth
VERRAZANO-NARROWS BRIDGE
SUSPENSION BRIDGE
VERT CL 217 FT
FOR MIDDLE 2000 FT
VERT CL 183 FT AT PIERS
VERT CL 229 FT
AT CENTER
Arrochar
South Beach
FLAGPOLE
HOSPITAL
TWIN TANKS
GRAVESEND BAY
Hoffman
WEST BANK
Swinburne
Norton Pt.
CONEY ISLAND
CHIMNEY
WEST BANK
E Int 6sec 69ft 14M
HORN
CHAPEL HILL NORTH CHANNEL
SWASH CHANNEL RANGE
SWASH CH
B A Y
EAST
Gp Fl(2) 18sec 54ft 13M
HORN
3B

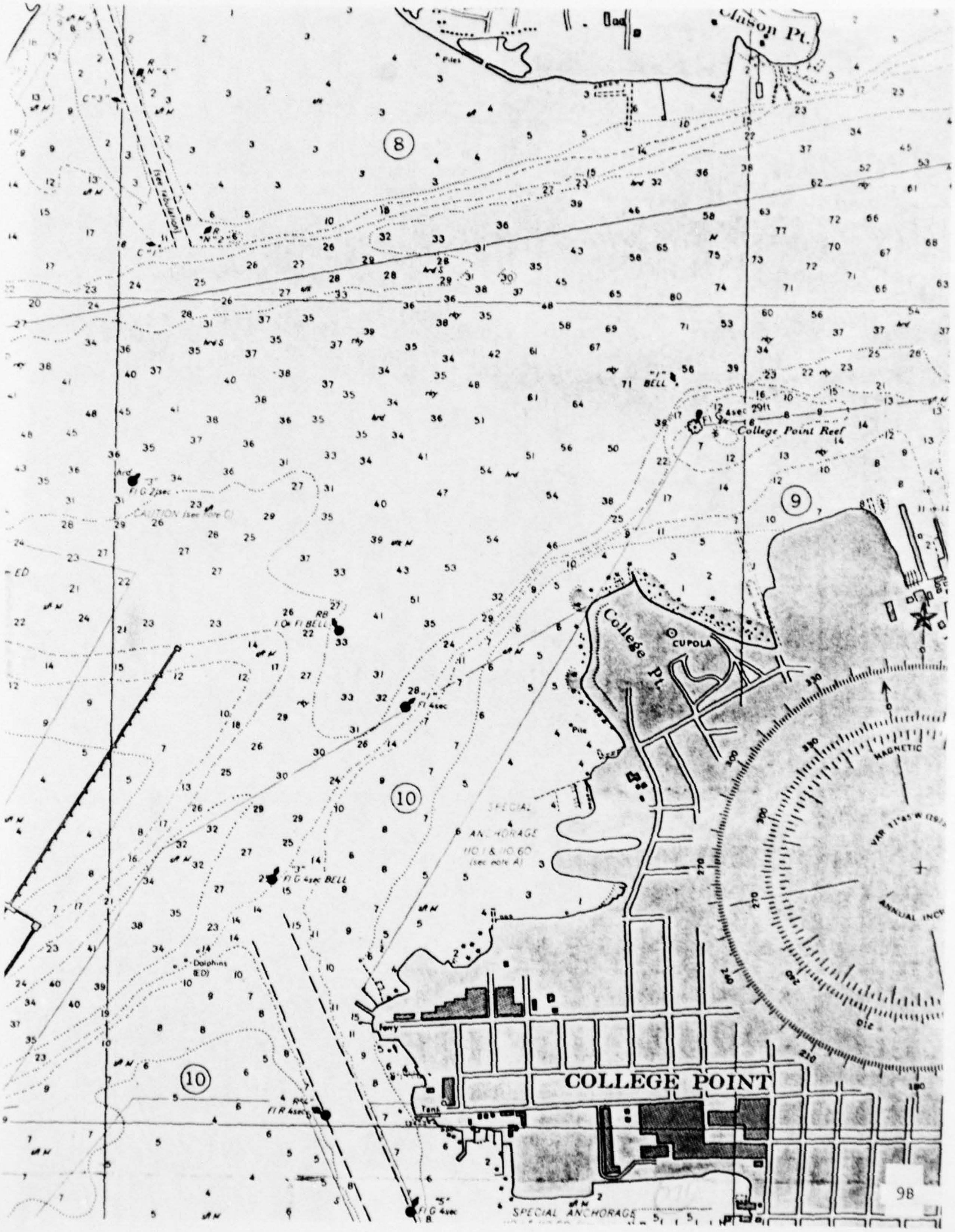

Greenville
Ellis I
Liberty I
STATUE OF LIBERTY
Governors I
Red Hook
BUTTERMILK CHAN
RED HOOK CHANNEL
BAYONNE TERMINAL
UPPER BAY
ROBBINS REEF
BAY RIDGE CHANNEL
Constable Hook
New Brighton
St George
Tompkinsville
Stapleton
CUPOLA
STANDPIPE
Clifton
TWIN CHIMNEYS
Rosebank
Grasmere
Ft. Wadsworth
VERRAZANO-NARROWS BRIDGE
THE NARROWS
Bay Ridge
RED TOWER
TALLEST GAS TANK
Fort Hamilton
CLOCK TOWER
Dyker Beach Park
FLAGPOLE
HOSPITAL

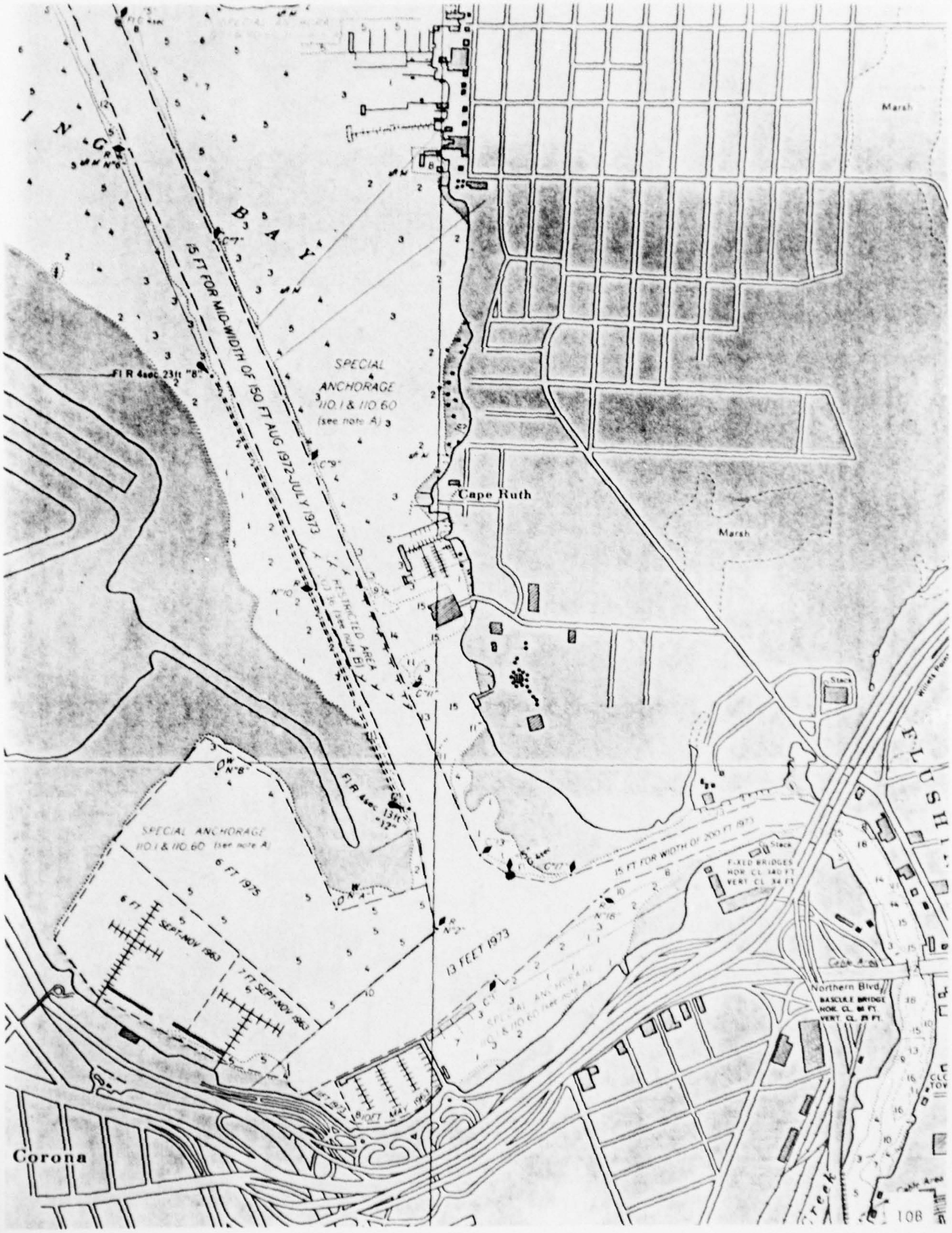
NEW YORK
CENTRAL PARK
RIVER
EAST RIVER
LONG ISLAND
NEWTOWN CR.
WELFARE ISLAND
ASTORIA
Horns Hook
Corlears Hook
TRIBOROUGH FIXED BRIDGE
LIFT BR. (CLOSED) HOR. CL. 403 FT. VERT. CL. 40 FT. DOWN VERT. CL. 99 FT. UP
QUEENSBORO FIXED BRIDGE
TUNNEL VENT.
TUNNEL VENTILATOR
RITZ TOWER
CHRYSLER BLDG
EMPIRE STATE BLDG
MET LIFE
GAS TANK
STACKS
GREEN DOME
FOUNTAIN
Calvary Cemetery
Maspeth
RADIO TOWER (WEVD) 1330 kHz
English Kills
WILLIAMSBURG FIXED BRIDGE HOR. CL. 1,138 FT. VERT. CL. 135 FT.
WOOLWORTH BLDG
FIRST NAT'L CITY BANK
DOHERTY BLDG
MANHATTAN FIXED BRIDGE HOR. CL. 1,200 FT. VERT. CL. 134 FT.
Wallabout Bay
FLAT TOP BLDG
TOWER (A.T. & T. CO)
R. TR.
Diamond Rf.
LIGHT VISIBILITY
The shorter of either the nominal or the geographic range is charted. See U.S. Coast Guard Light List for additional information.
NOTE B
Lights: one fixed green, two fixed white, one fixed red, and three fog lights each showing Fl 2sec
NOTE C
DANGER AREA
Area is open to unrestricted surface naviga


LITTLE HELL GATE
3 FIXED BRIDGES
MINIMUM CLEARANCES
HOR 112 FT
VERT 32 FT (AT CENTER)
TRIBOROUGH BRIDGE
WARDS ISLAND
TANK
STACK
Middle Ground
Stacks
Hog Back
Holmes Rk
Negro Pt.
GATE
Ways Reef
Pot Cove
Fl G 2 sec 33ft 7M
HORN
Hallets Pt.
ASTORIA
FIXED BRIDGE
HOR CL 830 FT
VERT CL 134 FT
FIXED BRIDGE
HOR CL (UNLIMITED)
VERT CL 138 FT
Shore Blvd.
Astoria Park
21 Drive
Ditmars Blvd
22 Road
22 Drive
23 Ave.
23 Road
23 Drive
24 Ave.
21 St.
19 St.
Hoyt Ave.
26 Ave.
27 Ave.
Astoria Blvd.
Main Ave.
30 Road
30 Drive
31 Ave.
31 Drive
12 St.
2 St.
3 St.
4 St.
8 St.
9 St.
12 St.
14 St.
14 Pl.
18 St.
Hallets Cove
CAUTION
Strong tidal currents of up to 5 knots, heavy swirls and heavy traffic in Hell Gate require extra caution on the part of the mariner to avoid accident or collision. See U.S. Coast Pilot 2, the Tidal Current Tables and the Tidal Current Charts for New York Harbor for additional information.
Hospital

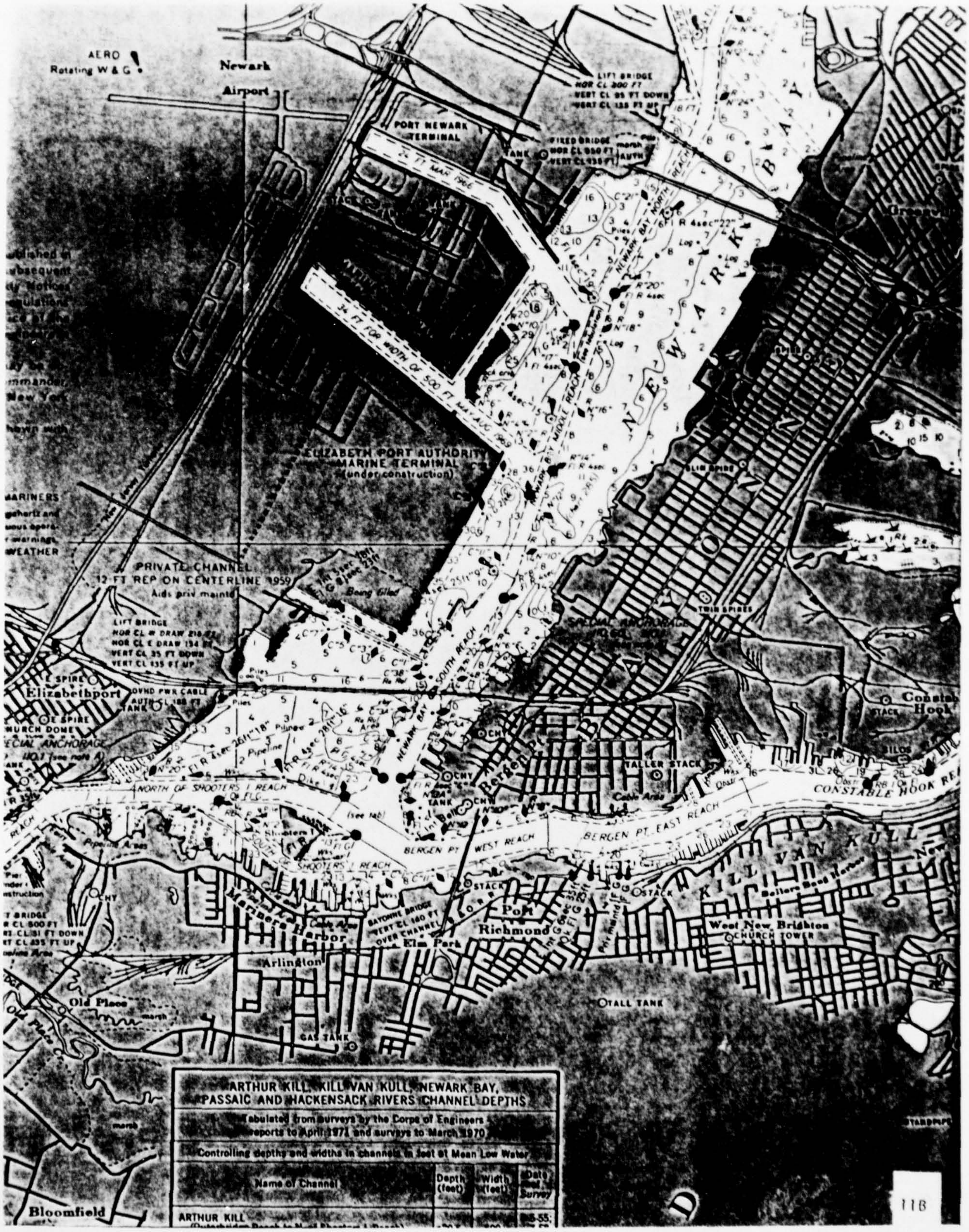

PORT MORRIS
TANKS
S.W. STACK
Stony Pt.
N Brother I
W. STACK
BELL
South Brother I.
30 FT SEPT 1971
LAWRENCE PT LEDGE
SOUTH BRO'T LEDGE
tide rips
Middle Ground
Being filled
Lawrence Pt.
Stack
Stacks
Cable and Pipeline Area
Shoaling reported 1974
29 FT FOR WIDTH OF 400 FT SEPT 1971
29 FT SEPT 1971
F R 20ft
Priv maintd
SPECIAL ANCHORAGE
MAGNETIC
7B

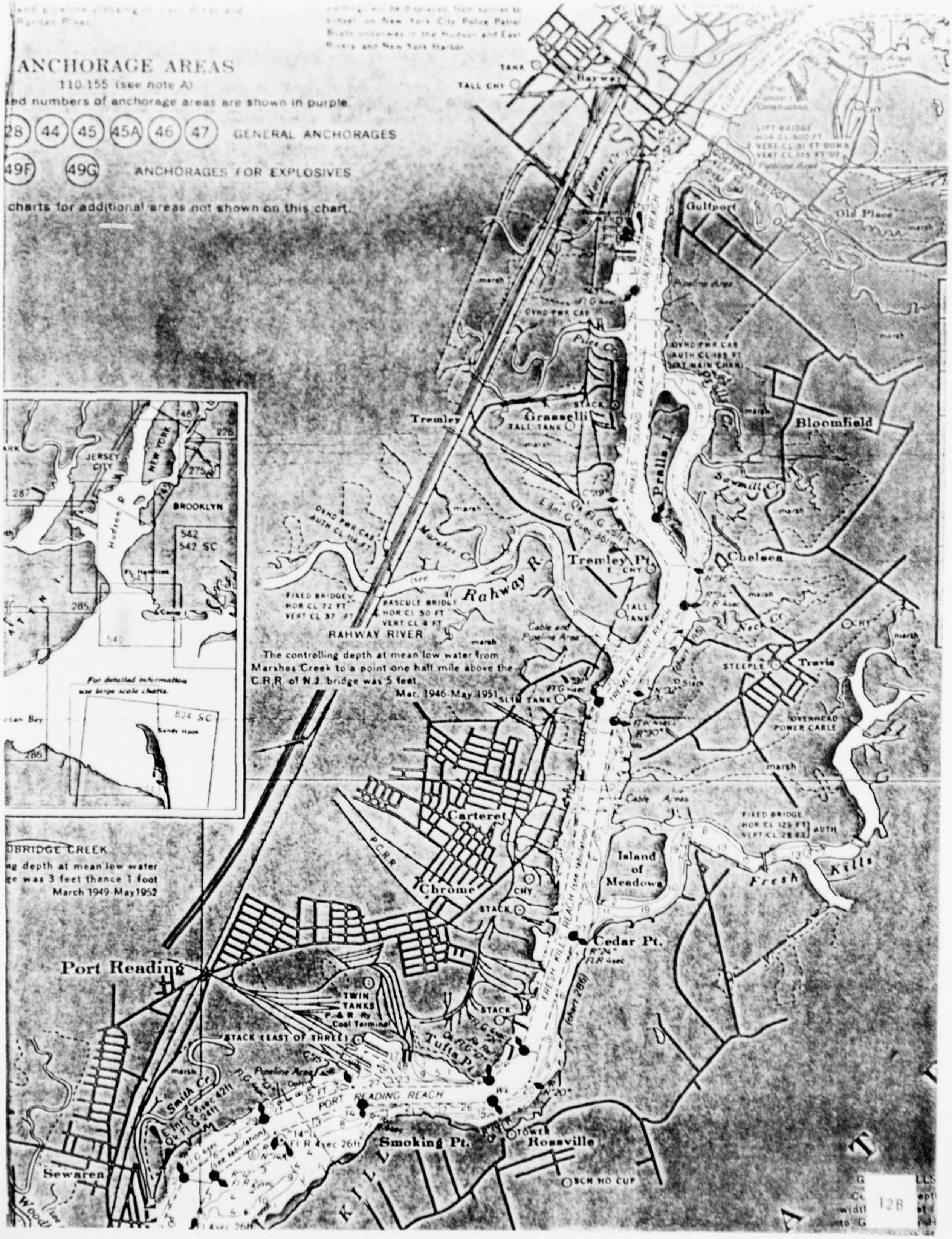

Barretto Pt.
TANKS
Hunts Pt.
STACK
STACK
TANK
Dolphin
RIKERS ISLAND
NOTE C
Vessels with mast heights in excess of 125 feet shall pass 100 yards to the north of East River Main Channel Lighted Buoy 3 so as to avoid vessel interference with aircraft on the glide path to the northeast-southwest runway of La Guardia Airport.
Vessels transiting South Brother Island Channel and using the turning basin at its southern terminus shall ballast prior to entry and are cautioned that mast heights in excess of 125 feet may penetrate the glide path to the northwest-southeast runway to La Guardia Airport. If mast heights cannot be lowered below 125 feet, La Guardia Air Traffic Control Tower shall be notified by phone prior to terminal departure or channel entry.
FIXED BRIDGE
HOR CL 125 FT
VERT CL 52 FT
subm
Rikers Island Channel


Clason Pt.
College Pt.
CUPOLA
College Point Reef
COLLEGE POINT
SPECIAL ANCHORAGE
MAGNETIC
Ferry
Tank
Piles
Pile
Dolphins

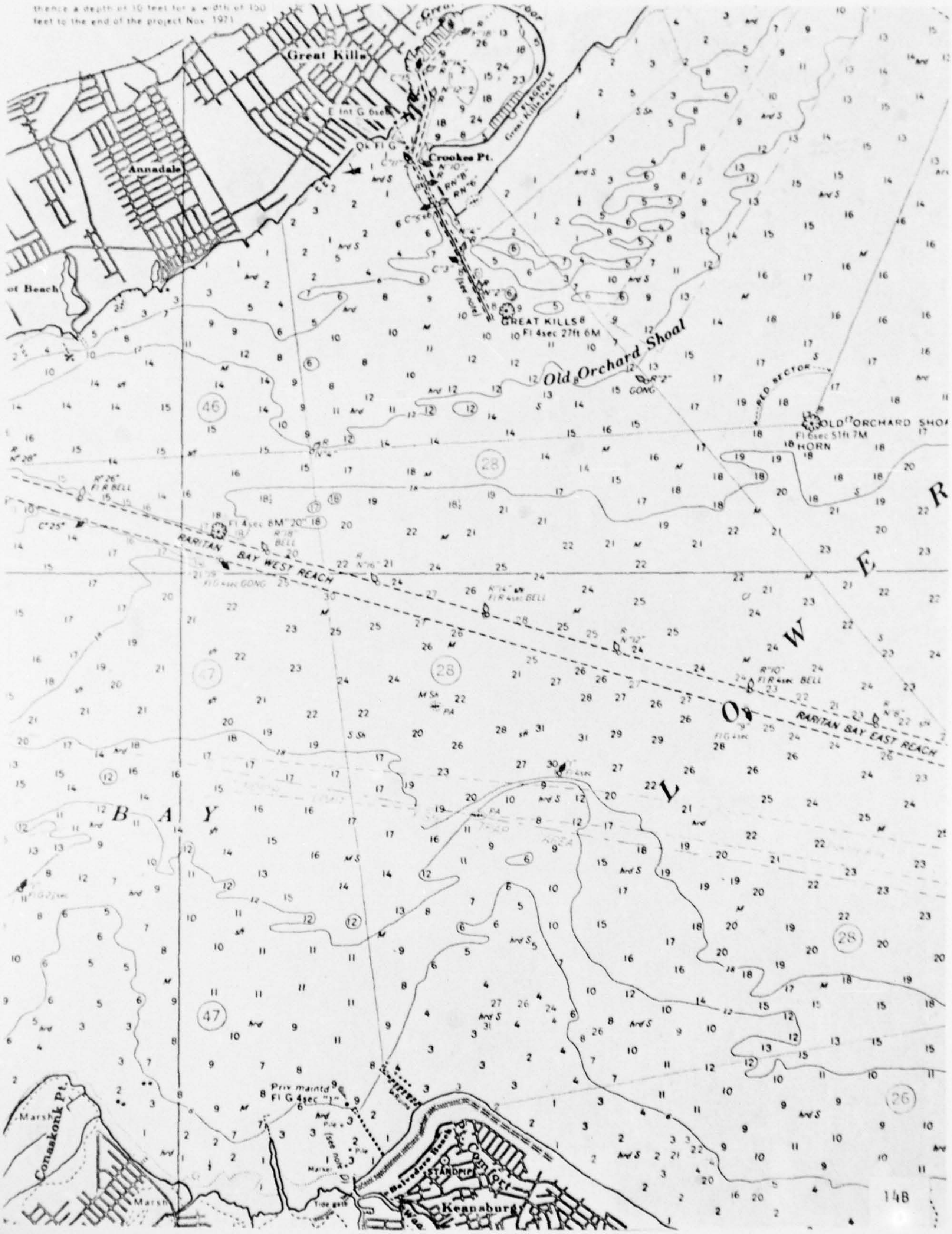


BAY
15 FT FOR MID-WIDTH OF 150 FT AUG 1972-JULY 1973
SPECIAL ANCHORAGE 110.1 & 110.60 (see note A)
Cape Ruth
Marsh
Marsh
RESTRICTED AREA
SPECIAL ANCHORAGE 110.1 & 110.60 (see note A)
6 FT 1975
6 FT SEPT-NOV 1963
7 FT SEPT-NOV 1963
13 FEET 1973
15 FT FOR WIDTH OF 200 FT 1973
FIXED BRIDGES HOR. CL. 140 FT VERT. CL. 34 FT
Stack
Northern Blvd
BASCULE BRIDGE HOR. CL. 80 FT. VERT. CL. 29 FT.
Corona

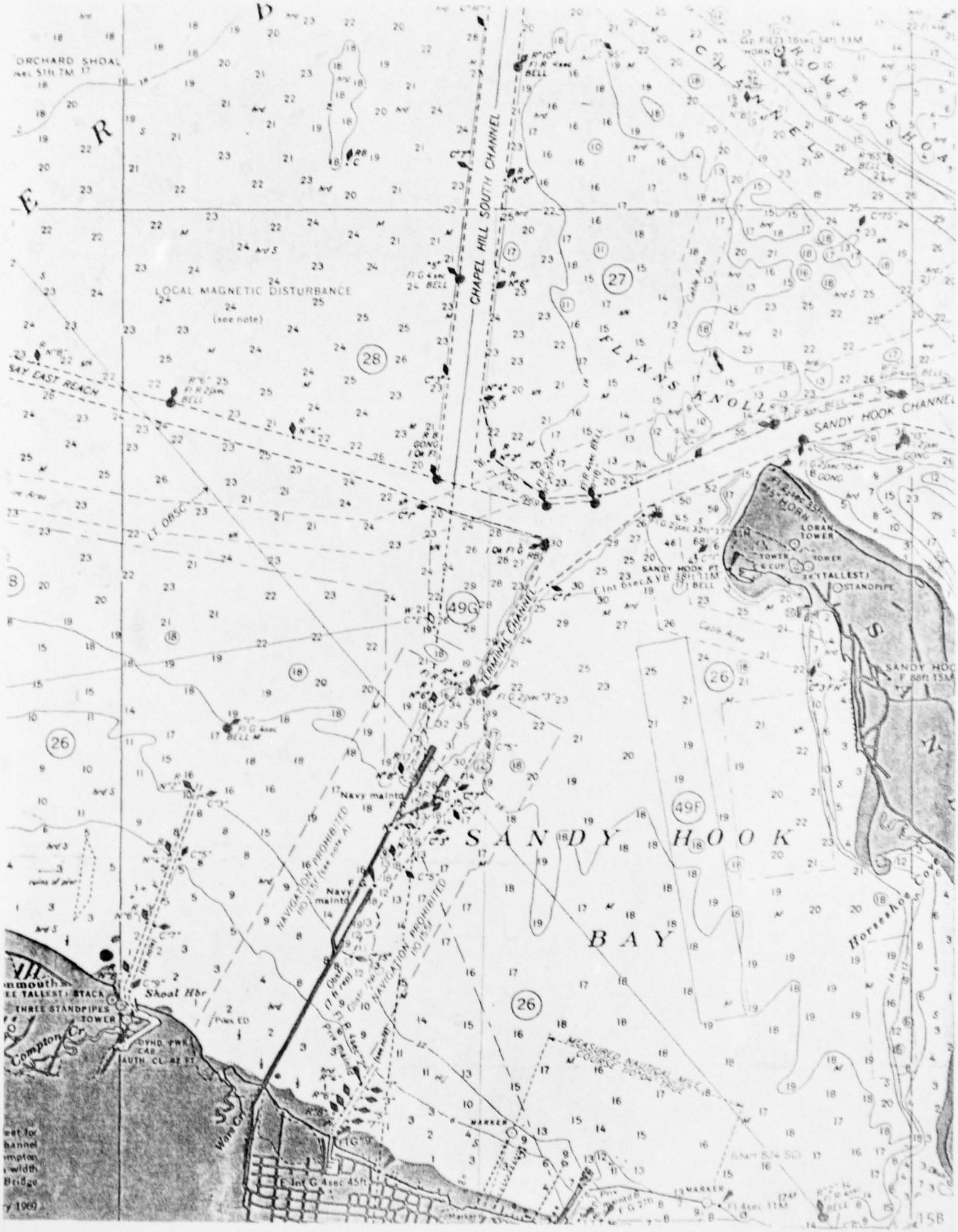

AERO
Rotating W & G
Newark
Airport
LIFT BRIDGE
PORT NEWARK
TERMINAL
FIXED BRIDGE
34 FT FOR WIDTH OF 500 FT
NEWARK BAY
ELIZABETH PORT AUTHORITY
MARINE TERMINAL
(under construction)
PRIVATE CHANNEL
12 FT REP ON CENTERLINE 1959
Aids priv maintd
MARINERS
WEATHER
LIFT BRIDGE
Elizabethport
SPECIAL ANCHORAGE
NEWARK BAY SOUTH REACH
NORTH OF SHOOTERS I REACH
SOUTH OF SHOOTERS I REACH
BERGEN PT WEST REACH
BERGEN PT. EAST REACH
CONSTABLE HOOK REACH
KILL VAN KULL
BAYONNE
TWIN SPIRES
TALLER STACK
Constable
Hook
BAYONNE BRIDGE
VERT CL 160 FT
OVER CHANNEL
Mariners Harbor
Elm Park
Port
Richmond
West New Brighton
CHURCH TOWER
Arlington
Old Place
TALL TANK
GAS TANK
Bloomfield
ARTHUR KILL, KILL VAN KULL, NEWARK BAY,
PASSAIC AND HACKENSACK RIVERS CHANNEL DEPTHS
Tabulated from surveys by the Corps of Engineers
reports to April 1971 and surveys to March 1970
Controlling depths and widths in channels in feet at Mean Low Water
Name of Channel
Depth (feet)
Width (feet)
Date of Survey
ARTHUR KILL

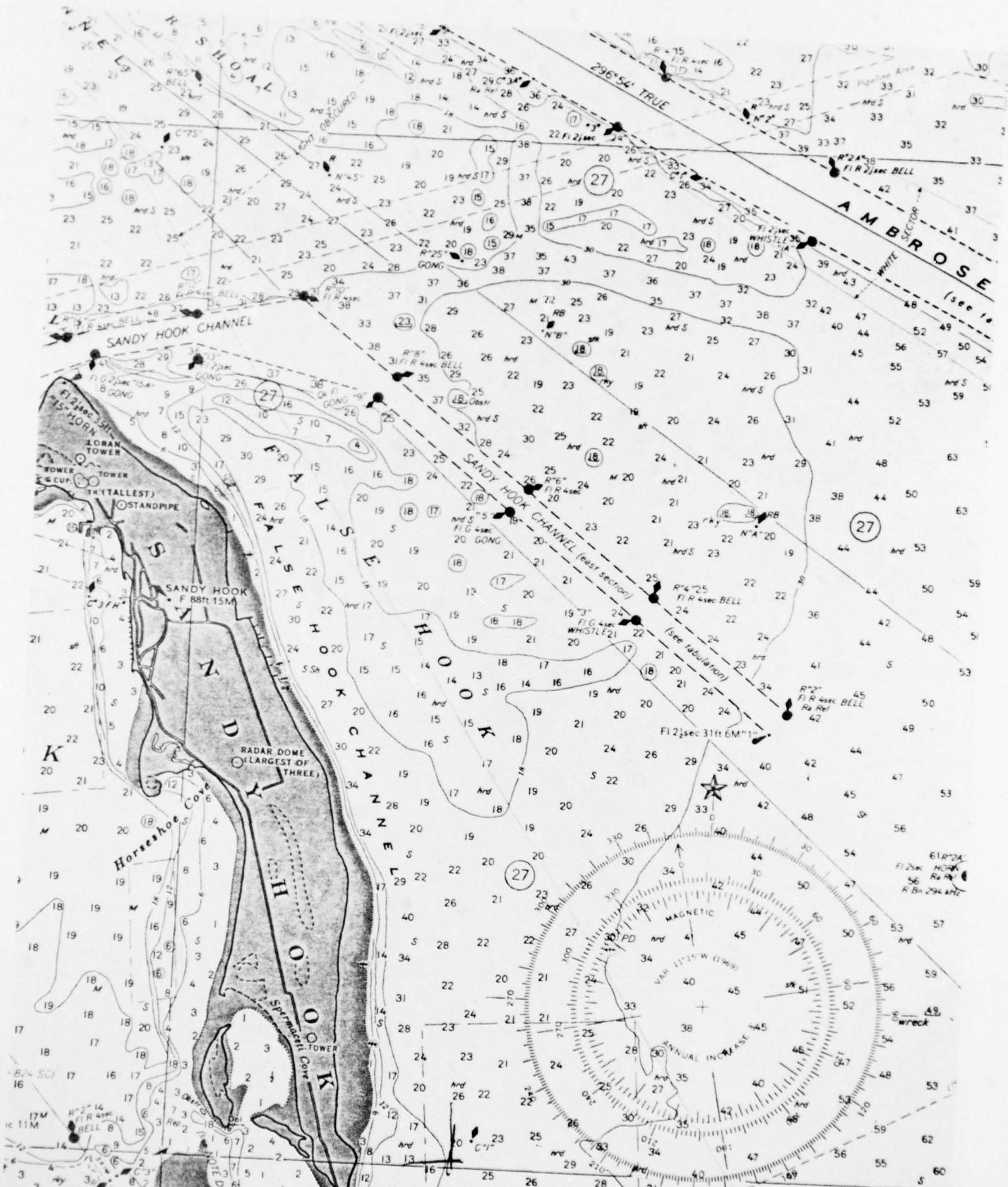

ANCHORAGE AREAS
110.155 (see note A)
ed numbers of anchorage areas are shown in purple.
28 44 45 45A 46 47 GENERAL ANCHORAGES
49F 49G ANCHORAGES FOR EXPLOSIVES
charts for additional areas not shown on this chart.
RAHWAY RIVER
The controlling depth at mean low water from Marshes Creek to a point one half mile above the C.R.R. of N.J. bridge was 5 feet.
Mar. 1946-May 1951
DBRIDGE CREEK
g depth at mean low water
e was 3 feet thence 1 foot
March 1949-May 1952
For detailed information use large scale charts.
JERSEY CITY
NEW YORK
BROOKLYN
Tremley
Grasselli
Bloomfield
Gulfport
Old Place
Prall's I.
Tremley Pt.
Chelsea
Rahway R.
Travis
Carteret
Chrome
Island of Meadows
Fresh Kills
Cedar Pt.
Port Reading
PORT READING REACH
Tufts Pt.
Smoking Pt.
Rossville
Sewaren
TREMLEY POINT REACH
FRESH KILLS REACH
FIXED BRIDGE HOR CL 72 FT VERT CL 37 FT
BASCULE BRIDGE HOR CL 50 FT VERT CL 8 FT
FIXED BRIDGE HOR CL 125 FT VERT CL 28 FT AUTH
OVERHEAD POWER CABLE
TWIN TANKS
STACK (EAST OF THREE)


Smoking Pt.
Rossville
Sewaren
Woodbridge Cr.
ARTHUR KILL
RADIO TOWERS (WPOW) 1330 kHz
Boynton Beach
Port Socony
Maurer
Kreischerville
S T A
Huguenot
OUTER BRIDGE REACH
SHOT TOWER
STANDPIPE
Ploughshare Pt.
OUTERBRIDGE CROSSING
CANTILEVER BRIDGE
HOR CL 675 FT
VERT CL 143 FT
Mill Cr.
Richmond Valley
Pleasant Plains
Princes Bay
Tottenville
PERTH AMBOY
Mt. Loretto
Hylan Boulevard
Red Bank
SEGUINE POINT BEND
Seguine Pt.
RARITAN R.
Sandy Pt.
SWING BRIDGE
Ferry Pt
RARITAN RIVER CUTOFF
WARD POINT BEND (WEST)
WARD POINT BEND (EAST)
Ward Pt
RED BANK REACH
Round Shoal
GREAT BEDS
GREAT BEDS REACH
SECONDARY CHAN
SOUTH AMBOY
Pipeline Area
BOUNDARY LIGHT
R A R I T A N
Being filled
Morgan
BASCULE BRIDGE
Laurence Harbor



thence a depth of 10 feet for a width of 150 feet to the end of the project Nov 1971
Great Kills
Annadale
Crookes Pt.
FLAGPOLE
Great Kills Park
GREAT KILLS
Fl 4sec 27ft 6M
Old Orchard Shoal
GONG
RED SECTOR
OLD ORCHARD SHOAL
Fl 6sec 51ft 7M
HORN
RARITAN BAY WEST REACH
RARITAN BAY EAST REACH
L O W E R
B A Y
Conaskonk Pt.
Marsh
Priv maintd
Fl G 4sec "1"
STANDPIPE
Keansburg
Tide gate
14B


ORCHARD SHOAL
CHAPEL HILL SOUTH CHANNEL
LOCAL MAGNETIC DISTURBANCE
(see note)
FLYNNS KNOLL
SANDY HOOK CHANNEL
TERMINAL CHANNEL
LT OBSC
LORAN TOWER
STANDPIPE
SANDY HOOK PT
SANDY HOOK
Cable Area
Navy maintd
NAVIGATION PROHIBITED
SANDY HOOK
BAY
Horseshoe Cove
Shoal Hbr
THREE STANDPIPES
TOWER
Compton Cr
MEASURED NAUTICAL MILE
MARKER



296°54' TRUE
AMBROSE
WHITE SECTOR
SANDY HOOK CHANNEL
SANDY HOOK CHANNEL (east section)
(see tabulation)
FALSE HOOK
FALSE HOOK CHANNEL
SANDY HOOK
F 88ft 15M
LORAN TOWER
STANDPIPE
RADAR DOME (LARGEST OF THREE)
Horseshoe Cove
Spermaceti Cove
TOWER
MAGNETIC
ANNUAL INCREASE
Fl 2½sec 31ft 6M "1"
R "2" Fl R 4sec BELL
R "4" Fl R 4sec BELL
R "6" Fl R 4sec
"3" Fl G 4sec WHISTLE
"5" Fl G 4sec GONG
R "2A" Fl R 2½sec BELL
wreck
Park

APPENDIX C

LISTING OF VIDEO RECORDINGS

APPENDIX C

	NAME OF VESSEL	TRANSIT	NO. TAPES	APPROX. VIEWING TIME (Minutes)
1.	Atlantic Cinderella	Ambrose Light - Port Elizabeth	2	110'
2.	Atlantic Cinderella (Edited version)	Ambrose Light - Port Elizabeth	1	30'
3.	Fortaleza (Early A.M.)	Ambrose Light - Port Elizabeth	2	120'
4.	Atlantic Span	Port Elizabeth - Ambrose	2	120'
5.	Sealand Galloway	Port Elizabeth - St. George	1	60'
6.	Fortaleza	Port Elizabeth - St. George	1	60'
7.	Toyota Maru #12	St. George - Port Elizabeth	1	60'
8.	Oriental Statesman (Early A.M.)	St. George - Bayonne, N. J.	1	60'
9.	Rio Iquazu	Port Newark - Bayonne Bridge	1	60'
10.	Arco Prestige	Stapleton - Tremley Point, N. J.	2	120'
11.	Tugboat Providence - Barge Sparkling Waters	Stapleton - Grasselli, N. J.	1	40'
12.	Olympic Games	Stapleton - Ambrose - Perth Amboy, N. J.	4	210'
13.	Stawanda	Ambrose - Port Reading, N. J.	3	140'
14.	Pasadena	Outerbridge - Sewaren, N. J.	1	30'
15.	Tugboat Providence - Barge Stonybrook	Port Mobil, Staten Island - Hampstead, L.I.	2	100'
16.	Great Republic	Bayonne Bridge - Howland Hook	1	60'
17.	African Dawn (Night)	Pier 5, Brooklyn - Verrazano Bridge	1	60'
18.	Tugboat Providence - Barge T-30	Flushing Creek - Great Neck, L.I.	1	60'

*U.S. GOVERNMENT PRINTING OFFICE : 1979 O-627-190/1757

METRIC CONVERSION FACTORS

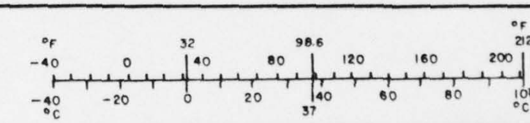
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in ≡ 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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