Introduction

THEORY AND HISTORY OF TECHNICAL COMMUNICATION

Technical communication, a form of writing often overlooked in literary scholarship, affords us a unique view of the discourse environments that make up our world. It provides examples of complex verbal and visual interactions of real people in the context of daily working life, not divorced from the communities in which they reside. This book is an analysis of layers of communication within a single industry between the years 1810 and 1925, the time during which the amount of technical communication began to increase exponentially. Most of these documents do not have a beginning, a middle, or an end; they are instances, fragments, or parts of a larger whole. Some are fragments of ongoing conversations, some are attempts to record present physical realities, some are self-promotion, but most are the visual and verbal remains of complex problem solving. From an analysis of technical communication at Lukens Steel, we can see that the industrial revolution would not have been possible without the attendant—and intrinsic—evolution of complex technical communication. Technical communication is a language essential to work in the modern world.

TOWARD A STRATEGY OF READING DISCOURSE COMMUNITIES

Behind this study is the notion that great stories are to be found not only in fiction, but in ordinary, everyday writing. Technical communication is seldom accomplished within a vacuum; it is usually a part of a larger ongoing community of speakers and listeners, writers and readers. Discourse communities are multiple, overlapping, and interactive; they have many authors, both named and unnamed, and many readers, both assumed and accidental. Just as we read fiction for stories with human interest, we can read technical communication for multiple complex stories with densely layered meaning. This strategy of reading can be applied to a single industry (as it is in these pages), to medical

literature, to pamphlets, sewing machine directions, corporate reports, train schedules, game instructions, online discourse—to just about every situation in which people communicate with text. The possibilities for analyzing social discourse communities within their context are limitless.

When technical communication is analyzed as part of a larger discourse environment, the reader needs to ask: Why was this document made? Who made it? Who used it? Where was it kept and how was it treated? What value did it hold in its own time and what value does it hold now? Such questions open the door into a rich textual world that has barely been noticed by traditional interpretative literary analyses. Reading in this fashion requires looking at the entire document—the physical properties, as well as words—the binding, the source, the illustrations, the media, and the condition. In short, it requires a multidisciplinary contextual analysis. This approach to interpreting technical writing can be called archaeological.

It is possible to analyze discourse environments in a variety of ways. For instance, an analysis could focus on a single subject across time or compare different subjects that exist at a single time. It is possible to analyze technical communication in an entire industry, a portion of an industry, or a specific instance of the industry. This book is an analysis of one instance (company) within the American iron and steel industry, Lukens Steel, that began in 1810 and is still operated by a global steel corporation today. Lukens Steel provides a good sample for analysis because it was managed by members of one family for over 150 years and they saved the majority of their papers.

The changes in American manufacturing can be seen in the changing discourse environment at Lukens Steel. The documents in the early years were mainly deeds, handwritten letters, and complex accounting books, which included daybooks, journals, and ledgers. After 1849 Lukens used letterbooks to record outgoing correspondence: freshly written letters were pressed onto damp tissue paper as they were written. Technical communication was sometimes included in the letters, such as product specifications, drawings, and discussion of faulty materials, but it was rare. It was an important step when the first record-keeping documents appeared on the factory floor in the 1890s. From that point on, in addition to the letterbooks used by management, there were records of steel output from the open-hearth and plate mills, records of incoming and outgoing material in railroad cars, records of defects, and other records, such as notebooks carried by the foremen as in the example seen below (Figure 1). After 1900 general written and visual literacy can be seen in a wider group of authors from the factory floor. Managers, workers, foremen, and business owners communicated by a series of notes on small paper sent in an intrafactory mail system. After the introduction of the typewriter and carbon paper, managers, foremen, and the owners communicated via a third party, the stenographer typist. From that point on the amount of technical communication grew exponentially.

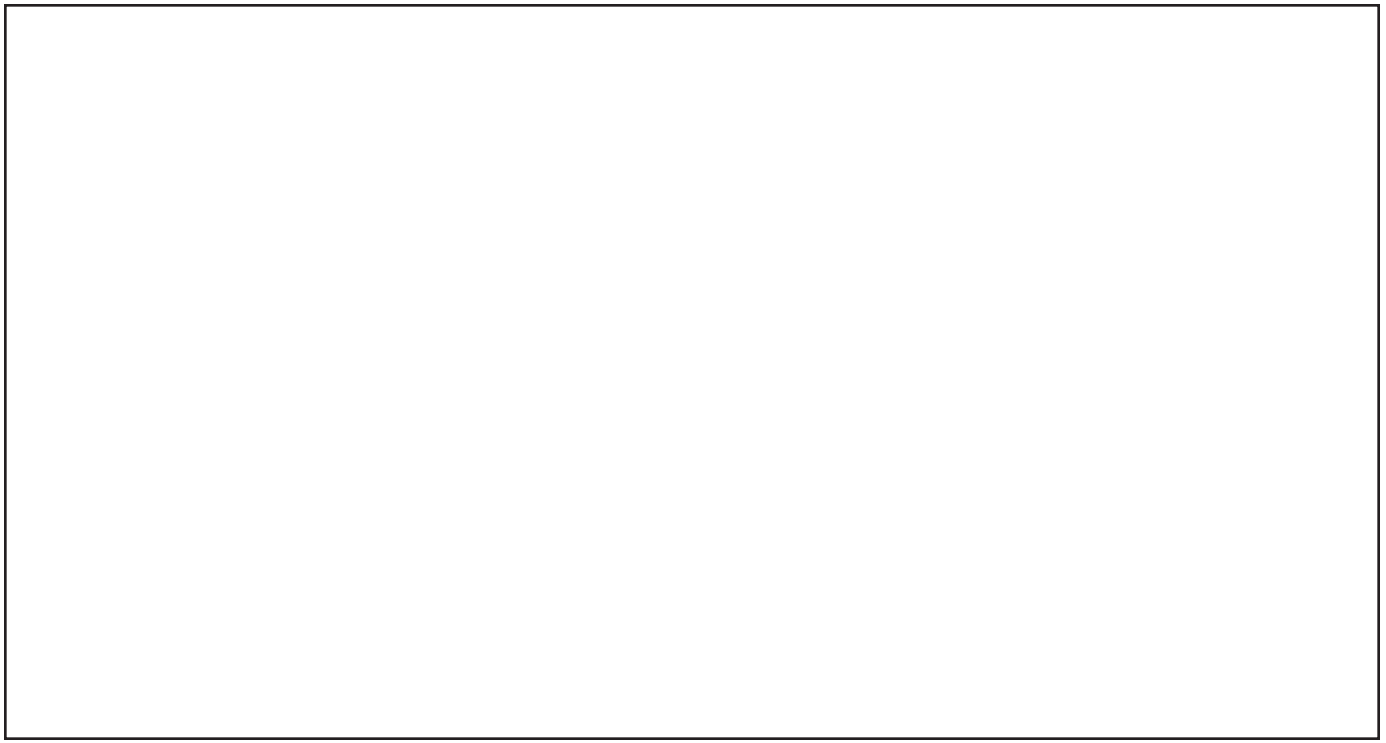

Figure 1. **Punch Drill Order Book by William Malallieu (1897).** Textual analysis can merge with archaeology to help raise fundamental questions—What is the physical presence of the document? Where was it found? What status did it hold? How was it used in the ongoing dialogues, or social discourse community?

The theory behind my contextual method of reading was shaped by several texts, including the work of Elizabeth Tebeaux, JoAnne Yates, Charles Bazerman, and Michel Foucault's *The Archaeology of Knowledge*. This chapter briefly discusses how their ideas preceded mine. Tebeaux was the first to look at all texts, including instructional manuals, as being of literary value worthy of further study. Yates was the first to analyze the changing methods of communication in the corporate world. Bazerman described the evolving form of the scientific report and how it met the needs of a discourse community. Technical communication is far more important than scholars, to date, have realized, and these authors have recognized that. Foucault was influential in that he advocated reading the entire discourse community, within its context, and understanding that separate utterances, statements or authored texts do not exist without that which has gone before and that which comes after—all are parts of an ongoing conversation.

Technical communication is a method of knowledge exchange that reaches across both time and space; it enables people to codify received knowledge and helps to generate new knowledge. In the early days of the American iron industry, technical communication happened prediscursively, between people in immediate proximity, and thus knowledge traveled slowly, often embodied within a human being. In the nineteenth century, however, there was an explosion of communication, and for the first time knowledge could travel as fast as the railroads, newspapers, and journals. Since innovators could compare ideas and results more rapidly, this hastened the rate of individual inventions and the combination of inventions, eventually creating the technological world we live in today. The importance of technical communication should not be underestimated—it is the text of knowledge.

FOUCAULT: THE ARCHAEOLOGY OF KNOWLEDGE

In Foucault's "Archaeological Method and the Discourse of Science," Cynthia Haller writes that Foucault's method enables us to see "discourse not as a product of authorial intention but as a matrix within which relations of knowledge and power in society are created, maintained, and transformed . . ." [1, p. 56]. In the matrix, the warp and woof are connected so that power can't move without moving knowledge, and vice versa. Social power relations will shape modalities of technical communication at the same time that the capacity for technical communication will shape and modify social relations. During the time span of this book, specialized technological knowledge was at first embodied in individual people, but gradually it emerged as notations on paper. As management moved further away from the daily work and the complexity of that work increased, technical writing became necessary in most parts of the plant, including activities on the factory floor.

In *The Archaeology of Knowledge*, Foucault wrote that "history transforms *documents* into *monuments*" [2, p. 7]. In our society we have chosen to make what we call literature the primary genre for monumentalization. By doing this we memorialize an individual consciousness in a state of retrospection. The rupture offered by Foucault invites us to choose something else. Technical communication is a discourse form that is an external dialogue rather than an internal monologue, an attempt to communicate with multiple people for multiple purposes. It has a subject and a goal—the trading and creation of knowledge—and it is the literature of a group rather than an individual.

Rather than seeing a book as a simple unity, with an author, a beginning, a middle, and an end, Foucault reminds us that "The frontiers of a book are never clear-cut: beyond the title, the first lines, and the last full stop, beyond its internal configuration and its autonomous form, it is caught up in a system of references to other books, other texts, other sentences: it is a node within a network" [2, p. 23]. All of the boundaries that we observe represent choices that we make. What is deemed important by us at any given point in time differs. Interestingly, Foucault also reminds us that, for every emergence of a text or document, there is much, much more that has gone on behind the scenes to make it happen. He writes, "Behind the visible façade of the system, one posits the rich uncertainty of disorder; and beneath the thin surface of discourse, the whole mass of a largely silent development . . ." [2, p. 76]. Technical communication is especially interesting, because in it we can see a web of knowledge exchange that results in actions in the world. Thus in technical communication we can hear multiple, interweaving voices in networks of dialogue.

The basic building block of Foucault's *Archaeology of Knowledge* is the statement, or utterance. He defines a statement as "A seed that appears on the surface of a tissue of which it is the constituent element," or in other words, as part of a network: "There is no statement that does not presuppose others; there is no statement that is not surrounded by a field of coexistences . . ." [2, p. 88]. In the case of the American iron and steel industry, the statement may take many forms: a scrawled note, a list of defects, a test report, a few words passed between workers, a letter with drawings, or a calculation. It is these elements that make up the larger discourse environment.

A discourse is a group of statements formed by specific discursive practices. Discursive practices consist of the assumptions and rules underlying a discourse (such as the methods for filling out a certain type of test report). When you approach language in this manner, new worlds and possibilities open up. Reading documents as statements from a discourse environment allows many levels of interpretation: such a strategy makes it possible "to snatch past discourse from its inertia and, for a moment, to rediscover something of its lost vitality" [2, p. 107]. Foucault also notes that, within discourse communities, some topics are prohibited. In a speech delivered to the Collège de France, Foucault said (as translated), "I am supposing that in every society the production of discourse is at

once controlled, selected, organized and redistributed according to a certain number of procedures . . . . The most obvious and familiar of these concerns what is prohibited. We know perfectly well that we are not free to say just anything . . ." [2, p. 216]. One of the prohibitions in the academic world today concerns the definition of "literature"; presently, it is defined as fiction, religious writing, poetry, and essays. There is a vast wealth of writing from the working world that can be studied in context and yet, because it is relatively new (expanding in the late nineteenth century), is not perhaps considered literature.

TEBEAUX: READING TECHNICAL COMMUNICATION

Elizabeth Tebeaux wrote the first book-length analysis about the role of technical communication in history in 1997, *The Emergence of a Tradition: Technical Writing in the English Renaissance, 1475-1640*. Using Pollard and Redgrave's *A Short-title Catalogue of Books Printed in England, Scotland, & Ireland and of English Books Printed Abroad, 1475-1640* as a source, she discovered hundreds of texts that have not been read or analyzed as part of the modern canon. She argued that "technical writing, like literature, history, and philosophy, is worthy of study in its own right" [3, p. 3]. She notes that studies of the English Renaissance have long been focused on "courtiers, drama, political intrigue, political and theological polemic, military and geographical conquests, love poems, catechisms, sermons and worship aids" and she suggested that reading technical writing provides "scholars of language a broader understanding of the characteristics of a period than literary or historical studies alone will afford" [3, p. 2]. In addition, reading technical communication as a literature within an everyday context can provide an unfiltered, contemporaneous glimpse of people working together in ordinary life.

Very little attention has been paid to writing about working people or ordinary working activities, such as "farming, gardening, animal husbandry, surveying, navigation, military science, accounting, recreation, estate management, household management, cooking, medicine, beekeeping, and silkworm production, to name a few," even though many of these documents are widely available [3, p. 3]. Tebeaux theorizes that little attention is paid to technical communication as literature because it bears "the taint of the marketplace and the non-academic world" [3, p. 3]. This is an example of how, as Foucault describes, discourse communities create their own rules of formation and prohibit areas of inquiry. Perhaps it's time to expand the boundaries of what we read and what we teach to have a richer and more accurate vision of the world.

Technical communication takes many different forms, which scholars have hardly even begun to address. Each type and instance of technical communication is part of an ongoing dialogue, an interconnecting, overlapping, responsive network with knowledge moving from node to node. Moreover, since examples

of technical communication frequently incorporate many visual elements, their analysis spills over into the field of graphic art. Layout is used to guide the eye, and drawings, woodcuts, photographs, tables, and graphs are used, in tandem with words, to attempt to communicate physical meaning. In 1983 John Brockmann noted that the history of technical communication had, until that point, focused mainly on great authors or scientists. This myth of the "genius in the attic" has long been a part of our culture. In reality, inventions emerge from multiple minds, and they emerge more rapidly when the minds are in communication: new technology develops cumulatively by a series of inventions, modifications and communications, rather than by a single person at a single time [4, p. 19]. We are gradually moving away from the myth of the heroic genius and toward a complex and nuanced view of the world and its functioning, as being composed of many people with many voices and visions. Brockmann suggested examining a "broad spectrum of writers," including those who are "uncelebrated," since it would be "immensely more accurate and meaningful" [5, p. 156]. It is time to look at the whole, rather than the part.

YATES: BEYOND INDIVIDUAL MEMORY

JoAnne Yates's *Control Through Communication: The Rise of System in American Management* brought business communication, another subset of transactional rhetoric, to the fore as a discourse worthy of analysis. Like Tebeaux, Yates is a pioneer who saw the possibilities in studying a form of communication that has, thus far, been overlooked by the majority of scholars: corporate communication. Yates took as her topic the evolution of corporate communication in the railroad and manufacturing industries during the nineteenth and early twentieth centuries. Just as Tebeaux outlines the history of how printing contributed to the explosion of knowledge in the fifteenth century, Yates examines how the railroad and telegraph changed the face of both business and communication. For instance, railroads were central to the evolution of business communication: they first required and then defined some of the fundamental underlying methods of modern corporate communication. Yates argues that the foundation of the modern corporation was created by the bureaucracy necessitated by railroads, which required accurate time tables and notification of accidents, as well as other exact data.

> Before 1850, the economy was dominated by small firms owned and managed by a single individual or a partnership and operating in a local or regional market. The spread of the telegraph and of railroads around the middle of the century encouraged firms to serve larger, regional and national markets, while improvements in manufacturing technology created potential economies of scale [6, p. 1].

Through the growth of rapid travel and communication, larger networks of business and industry were possible. These changes—the overcoming of geographical boundaries—were essential in making possible the technologically advanced society of today. The new distributed corporations were woven together with communication: for the first time, communication was necessary, on a daily basis, between all levels in the hierarchy of workers. "Only through such communication could managers have any hope of coordinating the many physically separated individuals and activities required to make the modern corporation work" [6, p. xi]. The structure that emerged in the railroads gradually spread to other industries. A large part of Carnegie's success in the steel industry was that he and his partners had originally worked in the railroad and telegraph industries, so they knew how to make use of this web of communications that could distribute texts and hold a large group together across time and space.

The increase in business communication is parallel to the increase in technical communication, and the genres overlap: at times technical material was included within business communication, and some business documents required technical information. The methods of communication in the two genres overlap as well: Yates described the telegraph, typewriter, duplicating methods, letterbooks, and filing systems, all of which were essential to the emergence of modern corporations. This communication was necessary to overcome the limitations of the individual memory: "The published rules, the journal of operations, and the monthly reports all reflected a desire to rise above the individual memory and to establish an organizational memory tied to job positions and functions, rather than to specific individuals" [6, p. 6]. In both cases the organizational and technical communication had to "rise above the individual memory." The creation and continuation of business and industry had become a group act rather than an individual one. Communication that had been used in small groups and family businesses became insufficient as the complexity of technology grew beyond the capacity of the individual mind. This is another reason for studying community, rather than individual, communications.

BAZERMAN: THE EVOLUTION OF SCIENTIFIC DISCOURSE

Scientific discourse is another form of communication, one which uses structure and precedent to arrive at discovery and consensus. Charles Bazerman approached scientific discourse from both archaeological and anthropological standpoints. He wrote about viewing "text as a historical event within the unfolding context" [7, p. 3]. Each member of a scientific discourse "writes as part of an evolving discussion, with its own goals, issues, terms, arguments, and dialect" [7, p. 5]. This viewpoint parallels Foucault's

archaeological theory of the relativity of texts and the evolving strictures of social discourse communities.

Like Yates and Tebeaux, Bazerman wrote about the power inherent within text. Yates wrote about communication creating structures of social power, and Tebeaux wrote about the knowledge dissemination that gave ordinary people more power over their lives. Bazerman noted that scientific writing has given us "increasingly immense control of the material world in which we reside" [7, p. 13]. Technical communication is embedded within a structure and creates power for its users. Massive iron and steel production would never have been possible without increased communication, including the interaction with the emerging fields of chemistry, testing, and standards that gave us enough power to build the complex infrastructure we use today.

Like the business communication that Yates describes, technical communication evolved and shifted in genre in order to fill a variety of needs. Words for many of the elements in the iron industry, such as the word "steel," were continually being negotiated and redefined. None of this discourse sprang fully formed from the head of Zeus. The same was true of the development of scientific discourse. Bazerman argues that "Symbolic systems react to experiences and situations, to contact with different communities and the formation of new communities, to struggles with old meanings deemed inadequate to account for emerging ideas and experiences, to the need to create shared understanding and agreement where none existed previously" [7, p. 21]. In his analysis of scientific articles, Bazerman found that the gradual emergence of its form was a product of consensus and that each article was the product of consensus as well [7, pp. 22-23].

The scientific article came to represent a distinct genre of writing and communication. In business and technical communication, forms shift continually according to need. Carolyn Miller defined genres as "typified rhetorical actions based in recurrent situations" that can lead to successful group action [8, p. 159]. Different forms of writing emerge and evolve to fill different needs. In the case of Lukens Steel, several new forms emerged at the turn of the nineteenth century, including intensive reporting of data, standardized forms, multiple copies of drawings, testing reports, and written technical communication between the owners, managers, foremen, and workers. Later, complex typewritten letters and reports created a new class of worker, the stenographer typist, who became essential to industry as well.

OTHER STUDIES IN THE HISTORY OF TECHNICAL COMMUNICATION

Brockmann wrote that studies of the history of technical communication until 1983 had mainly reflected the "great author" method of discourse analysis [5, p. 155]. The first articles about the history of technical communication

often focused on science as well. For instance, in 1960 Joel Shulman wrote "Technical Writers Who Became Famous as Scientists" and in 1961 Charles Hargis wrote "America's First Great Technical Writer" naming Benjamin Franklin [9, p. 10]. In the 36 articles in the 1983 Brockmann bibliography, about half refer to generic, institutional, or group matters and the other half are devoted to individual authors, especially Chaucer and Franklin. Examples of individual technical writers writing in isolation, such as Leonardo Da Vinci, can be studied as technical communication, but individual geniuses are the exception rather than the rule: they exist outside the context of working people in the working world. The reward for looking at technical communication within its context is seeing what happens in the a human network rather than an individual mind.

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Louise Rosenblatt was the first to attempt to "broaden the framework" of literature in *Literature as Exploration* in 1938. Rosenblatt distinguished between *aesthetic* reading (predominantly literary) and *efferent* reading (predominantly nonliterary). Aesthetic reading is focused on the personal whereas efferent reading is part of a group dialogue that seeks to be read for a specific purpose [11, p. xvii]. She pointed out that a literary work contains "a special kind of intense and ordered experience—sensuous, intellectual, emotional—out of which social insights may arise" [11, p. 31]. She broadened our reading of literary work to include the reader's response, and perhaps it is time to broaden it further to include that which has been historically called nonliterary. Technical communication is also about the senses and the intellect. What it lacks in emotion, it gains from its rich context, since it is almost always part of an ongoing group discourse.

Can technical communication be read as literature? According to Terry Eagleton, "Some texts are born literary, some achieve literariness, and some have literariness thrust upon them" [12, p. 7]. What we consider to be literature is our choice. The technical communication in the American iron and steel industry is multilayered, dialogic, and full of examples of writing, drawing, research, changing social relations, developing genres, and the growth of an industry. In this analysis of Lukens Steel, we can see an extraordinary company continually repositioning itself to survive. In fact, they stayed in business until 1998, and part of the plant is still being operated by a global steel corporation today. Lukens Steel was a fusion of family and worker, of intellectual inquiry and chaotic structure, of opposites and ironies, as can be seen in a painting of Rebecca Lukens on a military repair ship in 1947 (Figure 2). Other companies have their own characteristics as well and can tell different tales. The documentation that they produced, if they saved it, is a fluid conversation caught in time. It is a different sort of literature than a novel, but it still tells the story of human lives.

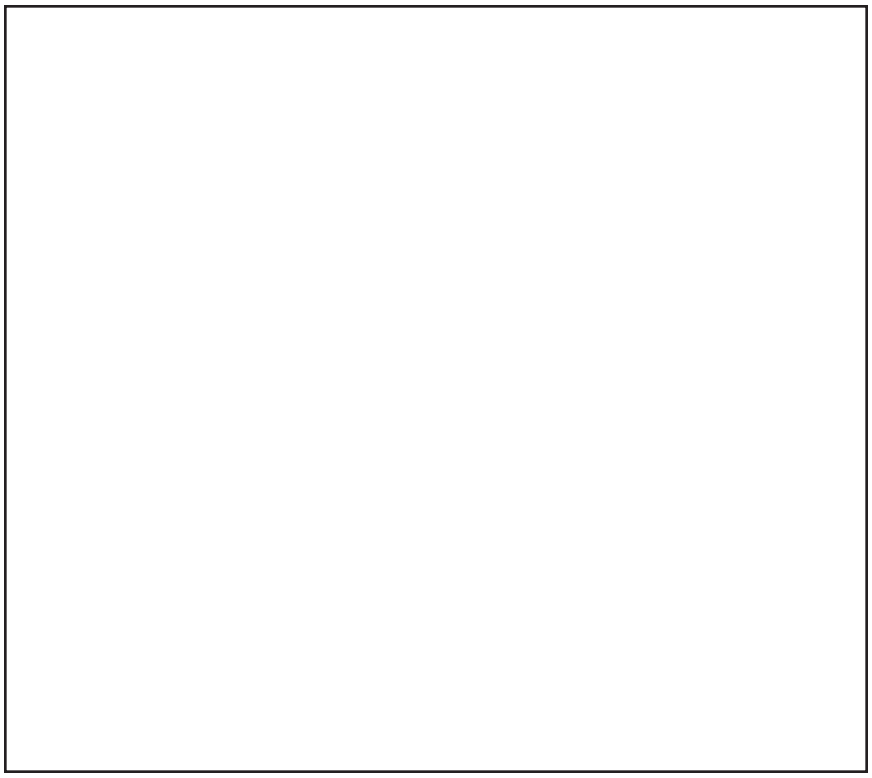

Figure 2. **Photo from Floating Aircraft Repair Unit, United States Army Air Force Special Services "Rebecca Lukens" (1947).** A nineteenth century painting of Rebecca Lukens as a backdrop for a repair ship that carried machine shops for precision work during World War II [13].

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