The story of designing and building the first open-hatch ship with 'rectangular' holds to carry newsprint

By R. Herbert

This is a story about the technical development of the world's first open-hatch ship, forerunner of many like her, bigger and better. It is also a story about people, as you will see, and to them is it dedicated.

My name is Bob Herbert. I am a naval architect and I worked in the consulting ship design office of Philip F. Spaulding of Seattle at the time all this took place. My generation of design engineers had come back from World War II determined to revolutionize the archaic world of merchant shipping. Fifteen years had passed – it was November 1960 – and some of us were getting nowhere with our ideas.

I was interested in the sea transport of forest products. Far to the north, in Canada, lie some of the world's greatest stands of fir, spruce and hemlock. The mills clustered along the bays and inlets of the Pacific Ocean, which convert the harvest of logs from these forests into everyday objects – lumber, plywood, paper – were marvels of efficiency and economy. These products, however, were not so easy to transport to the market place.

Newsprint, for instance, emerges from a paper mill as a heavy roll about 1 metre in diameter and 1.5 metres long, weighing around 730 kg. These rolls can be shipped in large quantities, thousands of tons at a time, very economically by water. But the simple task of lifting and stowing them within the ships' holds, and discharging them to shore at the end of their voyage, was antiquated and expensive.

The most common loading method was to lift one or two rolls by rope slings suspended from the ships' booms, which were rigged in such a way that the load could then be transferred horizontally in mid-air to a position over the ship, then lowered down through its hatchway to one of the several levels of decks inside the hold. Once landed and the slings thrown off, each roll was tipped over either onto its side or onto a two-wheeled hand truck, pushed by hand out into the sides of the hold and finally tipped back upright into its stowed position.

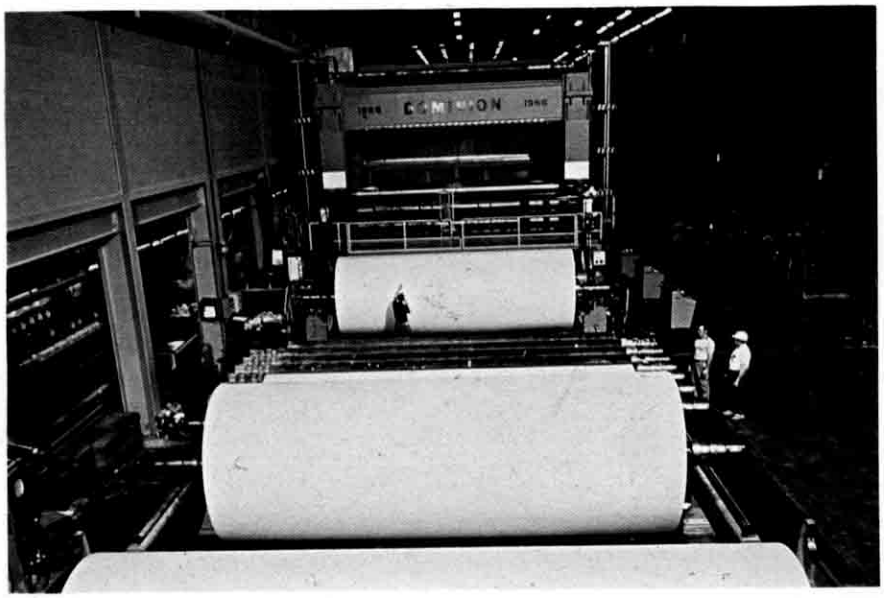
If a roll was not tipped up just right, it had to be pushed and levered by hand tightly against the other rolls so as to prevent movement during the voyage at sea. The last rolls in any one tier were swung and dropped directly into position while suspended in the slings; this required considerable pushing and sometimes took over 20 minutes just to get one roll properly landed.

When one complete tier was thus tightly packed, walking boards (pieces of plywood 1.2 metres square) were passed around and laid down to form a new floor upon which the next tier could be handled. Eventually an entire hold would be filled up in this way. Then the carpenters would come around to shore up any remaining gaps on top, and the hatch could be closed.

All this was just hard manual labour. Not much improvement had been made for many years. It took a long time for a lot of longshoremen, tied up the ship for days at each end of the voyage, and on some routes its cost added up as the biggest single operating expense of the voyage.

Some kind of technological breakthrough was going to be needed if this industry was to survive. Along with many others, I had studied the problem. The ideal solution was plain enough: some way had to be found to lift many rolls at a time and place them directly into a stowed position inside the hold. But to do this required that the hatch opening in the deck of the ship had to be as large as the hold underneath; such large openings had been believed structurally impractical. In addition, for safety and economy it would then be advisable not to employ longshoremen within these 'open' holds, and no one had yet figured out how to replace them with mechanical equipment.

So it seemed like a dead end. My boss Phil Spaulding came out of his office chewing on his



Previous spread and this page

From the forest to the paper mill. (Canadian Embassy, Paris)

cigar. 'There is a Clyde Jacobs coming up from Crown Zellerbach in San Francisco. He wants to talk about a new kind of newsprint ship. Meet him at the airport; you're going to go look at their mills in British Columbia.'

Clyde Jacobs turned out to be a young man about my age, which was surprising because in those days engineers and executives in the marine business were seldom taken seriously until they got some grey hair. But he too was fired with enthusiasm for some basic improvements, and his company had a reputation for encouraging innovative ideas. Crown Zellerbach is one of the largest paper manufacturers in the United States; its Canadian subsidiary produced newsprint in British Columbia at Ocean Falls and Elk Falls. These mills had their own deepwater terminals and regularly shipped newsprint by ocean-going ships down to San Francisco and Long Beach for use by newspaper publishers in these metropolitan California centres.

We flew north to Vancouver. There we boarded a small coastal ship for Ocean Falls, that being the only way in to this fjord-like region during the winter months. The fog drifted down to the sea and through it fell a deliberate rain. Besides mail and some freight for the coastal Indians living nearby at Bella Bella and Bella Coola, we had the coaster to ourselves with nothing to see beyond her bows.

Clyde and I sat alone in the pitching dining saloon and talked. He reviewed what we both knew; that the conventional ships presently being used to haul this newsprint, totalling some 250,000 tons yearly, though efficient by current standards, were slowly pricing themselves out of this trade by their steadily increasing cargo handling costs.

Finally Clyde asked 'Why were naval architects so stubbornly set on small hatchways? Why could not a ship be built with hatches just as big as the cargo holds underneath so that the newsprint could be placed directly into its stowed position by cranes?'

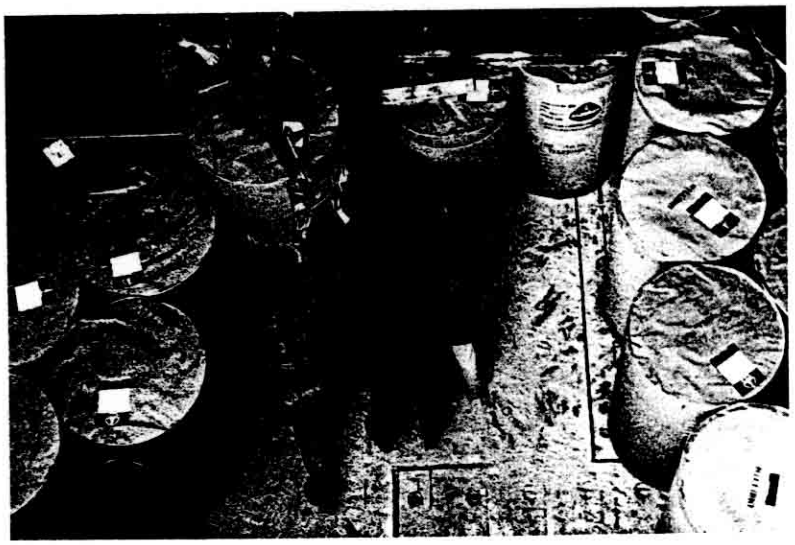
I ticked off what little I knew: container ships, then in their infancy, were beginning to use large

hatchways to permit direct access to vertical stacks of containers stowed below decks. The structure of these ships was compensated by very heavy steelwork in the narrow strips of deck remaining on each side of the ship; also their hulls were ringed with large web frames projecting inside into the cargo hold spaces at intervals between rows of containers. We could not stow unprotected newsprint around these frames; they would damage the cargo.

There were, however, other precedents. A floating drydock is built in the shape of a giant 'U' without any web frames projecting inside into the working area. The sides and bottom forming this open-topped 'U' are doubled with continuous steel plating inside and out; the spaces in-between form seawater tanks for sinking or floating the dock.

Floating drydocks are not built to withstand the constant working felt by a seagoing ship. But we had recently applied this principle to the design of a large barge intended for rough coastal service, and I believed it could also be worked into a full-fledged ship. Phil Spaulding had taught us not to side-step difficult questions, so finally I gulped out 'Yes OK.'

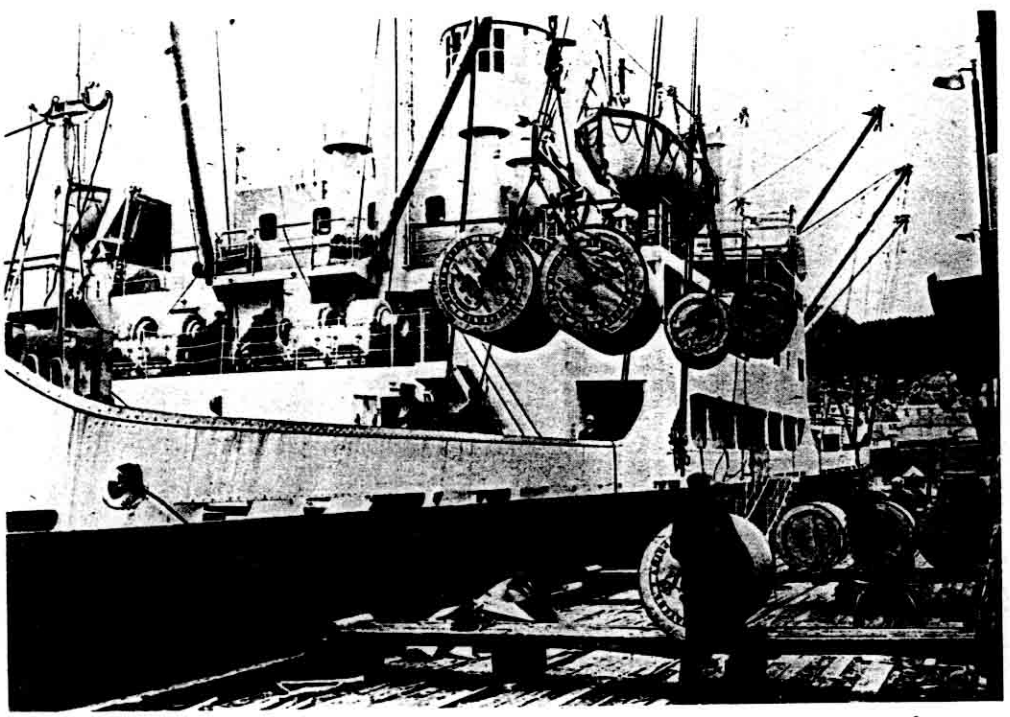
While we were at it we decided to eliminate all interior decks. The cargo hold was to become just a giant open-topped box, completely smooth-sided. We would stack the rolls of newsprint one on top of another the full depth of the hold, more than three storeys high. We did not know whether the rolls at the bottom could withstand this weight, but believed it worth trying.



Hand stowing on wooden tween-deck hatch covers of a classical ship in 1955.
Usually, four men would tip one roll over on to its side, roll it out from the hatchway into the wings of the hold and finally tip it back upright into position. (R. N. Herbert)

Next came the question of how to move the newsprint rolls in and out of the ship. We thought a lifting unit of eight rolls at a time was about right. Rolling gantry cranes could be placed on board to position the unit and lower it carefully down into the hold without manual assistance to form a tight fit against its neighbours or the sides of the hold. These gantry cranes also were novelties aboard ship; a few were being used by some of the early container ships but they were then far from being reliable.

How to attach the rolls to the crane? We could



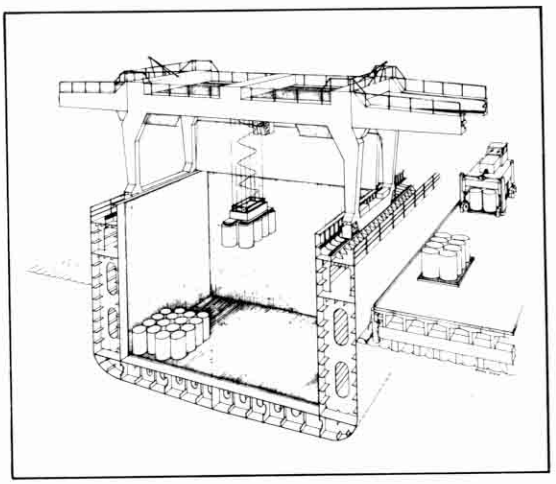
Loading paper rolls piece by piece or two by two on classical ships. (Canadian Embassy, Paris)

Right

Designing an 'open' ship with square holds and a 'finger' type handling for a unit load of 8 rolls of paper. (R. N. Herbert)

hang each roll individually in a rope sling looped over hooks on a spreader frame suspended from the crane lifting wires. But this would require more manual labour to place and remove the slings; worse yet, the rolls would all hang at different angles preventing tight stowage.

An obvious solution would be to pre-stow the eight rolls on a large platform or 'bolster'. The bolster could be hooked to the spreader and lifted aboard as one unit. This would be like handling containers without their enclosing sides and roofs, and had actually been tried some years before on an otherwise conventionally-built ship. But we were sure that the steel framework of these bolsters, when piled up inside the ship, would crush and tear the unprotected newsprint



Handling 8 rolls at the same time with a specially designed spreader. (MacGregor)

beneath and alongside it. Besides, we had both studied this idea before and found the same answer: it added the cost of purchasing and maintaining a large number of bolsters without a significant offsetting reduction in labour costs.

All this was being talked out as we sat in the dining saloon of the coaster. A small mountain of napkins had been covered with sketches and numbers, and the remaining table space was filled with half-empty water glasses. Finally Clyde thrust four fingers of one hand into four water glasses, pulled them together into a tight cluster and waved them under my nose. 'If I can lift four glasses with one hand, why can't we lift eight rolls of newsprint with a clamp built like two hands?'

There it was; the challenge lay ahead of us both. We had to build an 'open' ship which might not hold together, cover it with hatch covers bigger than any we knew, place on it rolling cranes which had not yet been designed, load and discharge newsprint eight rolls at a time using clamps functioning something like Clyde's hand, controlled only by a crane driver sitting in a cab five storeys above the bottom of the hold, and finally send the loaded ship out to sea not certain if the whole cargo might collapse under the forces of rolling and pitching.

If everything succeeded it would greatly reduce shipping costs; it would keep ships in business. If just one part failed, the whole enterprise would be ruined. We finished our trip and got down to work.

It takes a while to design a ship, especially one like this. Phil Spaulding listened to our plans, stubbed out his cigar, and commented 'Well, it all stands or falls together. You just make sure it stands.'

In the design office we drew the ship from the inside out. This was a departure. Usually a new design was first set down on paper as an external hull form suitable for its intended service and speed; then the inside spaces were divided up by a series of compromises. But our design began

with six perfectly rectangular 'boxes' or cargo holds, each sized precisely to stow newsprint rolls, with exactly the right clearances to allow easy handling but prevent excessive movement at sea. Next we figured the structural members necessary to support these boxes and tie them all together and to the engine room at the aft end of the ship. Finally we laid down lines showing the hull form wrapped around all these internals.

The result was dreadful. The front end especially looked like a duck's bow. Phil took one look and said gently, 'You know, Bob, it's just a fact that seagoing ships have to be pointed on both ends.'

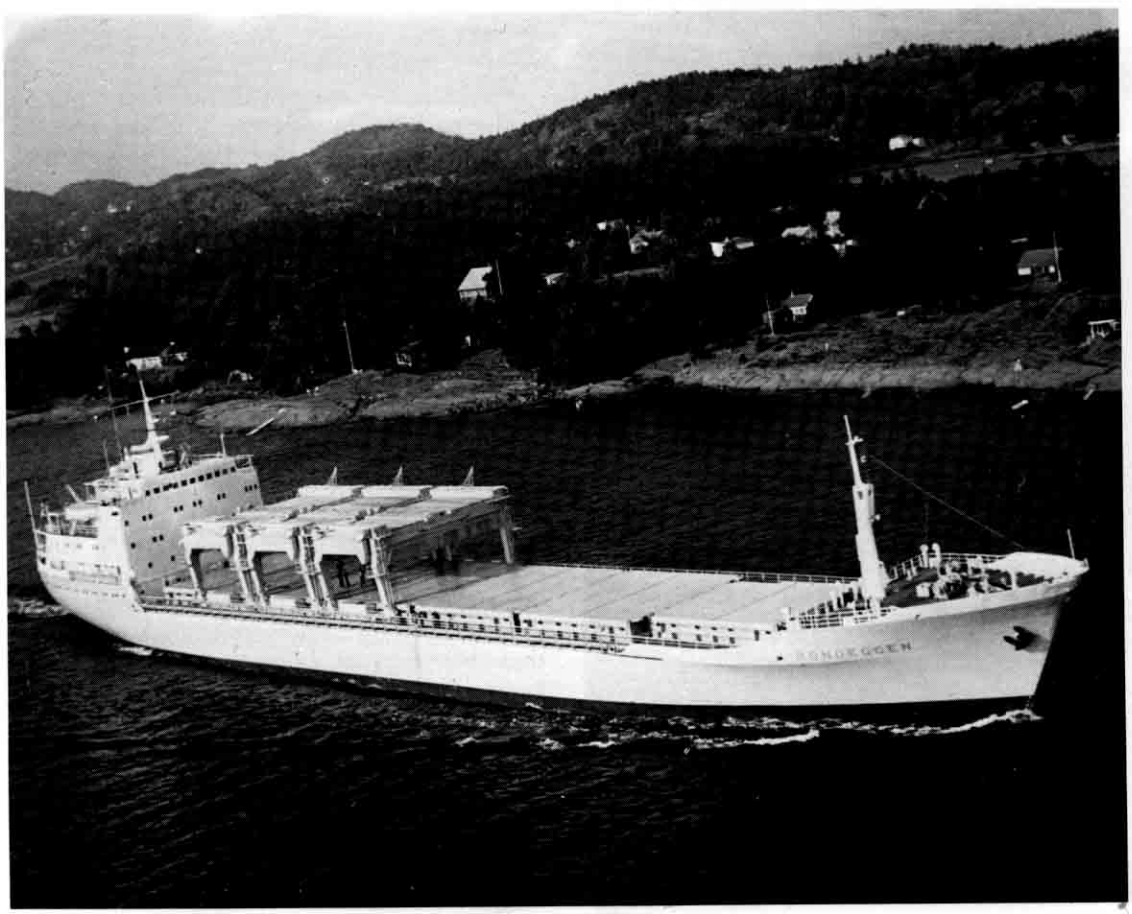
We tried again. Finally we got an acceptable compromise by cutting away the bottom corners of the forward and aft cargo holds in a series of rectangular steps, each the size of one or two rolls of newsprint so as to maintain the basic rectangular stowage pattern.

By March 1961 our plans and specifications were complete, and they were mailed out to prospective owners and shipyards for bids on two ships. The prices came in about as we had predicted, and contracts were signed with Chris Østberg of Oslo as shipowner, and with Kaldnes Mek. Verksted A/S of Tønsberg, Norway, as builders.

Chris Østberg owned ships which had been transporting Crown Zellerbach's forest products down the coast for some years. He was therefore very familiar with the problem, and had also become convinced that major changes were inevitable. Chris further assured us that he and his son Nils would personally watch over every detail at the building yard to make sure there would be no slip-ups in communication, or in carrying out our intent. This last was crucial because the arrangements and structure around the cargo holds were totally unfamiliar.

Kaldnes is a fine shipyard. They immediately started their own working drawings, air mailing them over to us in batches for review as they went along. I went over their structural details showing the main deck with special care. With such wide hatchways, there was not much top steel left; it all had to work together. The slightest discontinuity could form a dangerous concentration of stresses. Indeed, in the early days of welding it was a matter of record that whole ships had broken into two halves because of structural cracks spreading out from just such 'notches'.

One such detail, showing the connection of the cargo hatch coamings to the main deck, troubled me. I had visions of our ship cracking up out at sea. I asked for heavier steel and a different connection detail; Kaldnes' engineers disagreed. It



The Rondeggen — *L* × *B* *140×19.5 m, 9,000 dwt, 6,000 paper rolls, s.s. 15 kn.* (Munck International)

is a measure of the degree to which naval architecture is an art as much as a science that no one then could calculate exactly which structure would be correct. Finally we did it their way, but for a long time afterwards whenever I boarded the ships I would always go first to look for a crack. Kaldnes was right; I never found any.

Another big design hurdle was the hatch covers. Those wide-open cargo hatches had somehow to be closed up watertight at sea, and the covers had to be strong because we intended to stow lumber up to 3.70 m high on top as deck-load. Our early design solutions were clumsy. Kaldnes called in the international specialists MacGregor Comarain SA; their engineers came up with what at that time were the largest hydraulically-powered, hinge-up folding hatch covers in the world. Their Norwegian licensee, Norsk MacGregor, built the covers and supervised their installation.

Meanwhile, we had to find manufacturers for the big gantry cranes and the mechanical clamps for lifting eight rolls of newsprint. We made a false start with an American crane manufacturer and lost valuable months. By the end of 1961 that contract collapsed, and in February 1962, with the construction of the ships well under way at Kaldnes, we flew in some desperation to Bergen to talk to the Norwegian crane manufacturer Sverre Munck A/S. There we met young Fredrik Munck and his assistant Olaf Marve. This company had never before built just such a gantry crane. What we were now asking was, if they could please start from scratch and somehow manage to design and build six of them for the two ships; yes, and by the way, the first three to be ready for lifting on board in ten months! These Bergen Norwegians are truly Vikings; Fredrik merely looked up and grinned 'Yes, of course.'

And do it they did. Those first Munck cranes were of superb construction and are still in daily use. They set a standard of excellence for the entire industry.

Clyde Jacobs continued to search for a company which knew how to build mechanical newsprint clamps. Finally he settled on the Mansaver Company of New Haven, Connecticut. They had built clamps for lifting one or two rolls at a time. Clyde showed them his water glass demonstration and they got the idea for lifting eight.

One day Clyde remarked, 'There is such a thing as doing something, and then there is getting something done. They're not the same.' By that he meant that all the while we engineering types were happily fussing over our mechanical creations, he was striving just as hard to put together an organizational structure and operating team so as to make sure the new technology would be utilized to its fullest potential. He gathered around him a crack team: Frank Drews, and a little later Bob Lawson, Charles Gulbe and Wes Souply. These men, together with the managers of the mills and terminals, and their staffs, are the individuals who finally made it go. In all this Clyde's own bosses, Jack Vollmar and Harvey Oakes, added their authority and full support, not perhaps without an occasional doubt whether we really knew what we were doing.

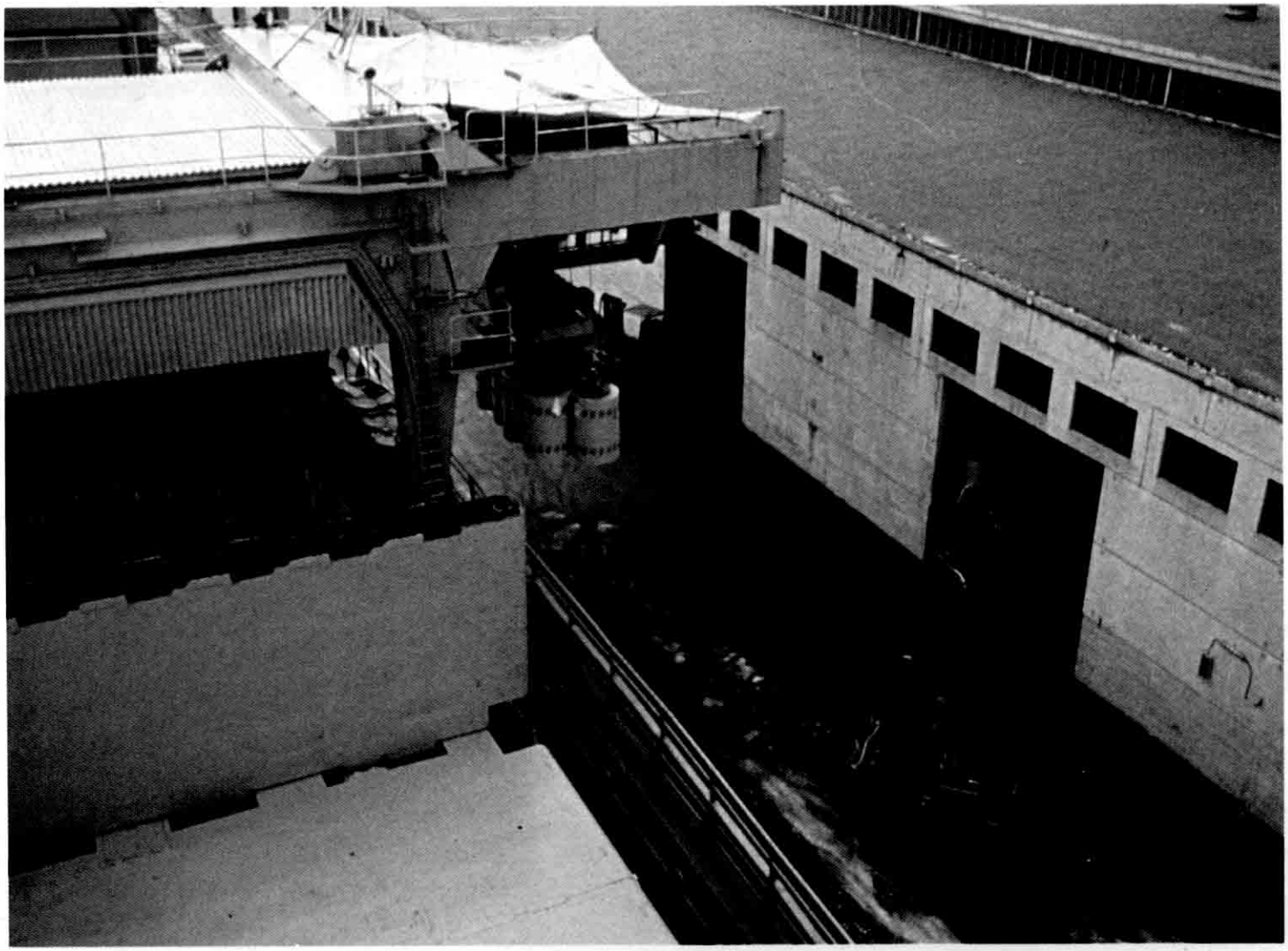
From the beginning there had been expressed legitimate concern over the acceptance by the Longshore Union of such radical changes in their traditional work methods. Indeed, there had been sceptics who predicted we would end up with the same labour costs as before; we would have to pay the longshoremen just to stand around while overall productivity would be changed little or not at all.

Such predictions might have been valid only a few years before. But our whole project had been given a mighty boost by two men: Mr J. Paul St Sure of the Pacific Maritime Association, and Mr Harry Bridges of the International Longshoremen's and Warehousemen's Union. After years of sometimes bitter dispute on the Pacific Coast waterfronts, and more years wasted in the late 1950s while a government-sponsored team of experts tried to impose scientific 'standards', these two men sat down together and cut the knot with a businessman's solution – a reasonable compromise. The result was the Mechanization & Modernization Agreement of 1960.

Under the terms of this agreement an employer could decide how many longshoremen were needed for any particular job, and how it should be done, so long as he did not thereby create an 'onerous' condition of work.

Below and right

Discharging paper rolls with a shipboard gantry crane; type of handling quite similar to the container operation.
On the quay, the rolls are taken off by fork lift trucks or terminal trailers. (MacGregor)



We were among the first wholly new projects tailored to this agreement. Our fully mechanized operation would require only two crane drivers for each crane (one relieving the other) plus two 'swingmen' standing by to assist with placing the walking boards, sweeping sawdust or dirt off the tops of the rolls or slinging out the occasional tipped-over roll. This four-man gang, with supervision and assisted by shoreside handling crews, could load or discharge up to 300 rolls hourly as compared with the traditional twelve-man gang averaging around 50 rolls per hour.

Both Clyde and I were haunted by one question which was crucial and yet could not be answered until the ships actually went into operation. Could a crane driver, all by himself up in a glass-enclosed cab as high as five storeys above the cargo, manipulate the control levers delicately enough to position the ponderous clamp and its load of eight rolls exactly into its assigned space within just a few millimetres? To make matters worse, the load would be hanging by wire ropes like a giant pendulum with the ship rolling, even if gently in port, underneath it. Clyde tried simulating this by lowering weights from string down to the ground from his upstairs bedroom. I read all the books I could find, and climbed into a similar crane cab on shore to see what it looked like from up there.

In the end we decided this question was like asking a scientist who had never seen the game of baseball to calculate whether the human eye could, in a fraction of a second, determine the precise location of an approaching 8 cm diameter object travelling at 80 km per hour towards him, and instantly position his arms so as to hit that object with a stick 6 cm in diameter. The scientist would obviously declare it to be impossible. We would just have to wait and see.

By September 1962 the first ship was launched at Kaldnes and christened MV *Besseggen*. After the ceremonies, an old seaman walked over to the hatch coaming, spat into the open hold below and muttered half to himself, 'Now that's the way to build a cargo ship.' We were elated; here was our first real endorsement!

December 1962: a bitter wind swirled snow against the frozen steel. Kaldnes' shipyard crew

worked with bare hands to complete the *Besseggen* on time. I inspected her inch by inch to make sure all had been done properly. Everything checked; she was well and truly built. Kaldnes had done their best to help our venture succeed. On sea trials she exceeded her guaranty speed and to me her bows arose through the seas beautifully, as if she lived.

But the three great Munck cranes were not yet installed. Each crane weighed over 140 tons and was to be lifted onboard virtually fully assembled. *Besseggen* was shifted to the Framnaes Yard nearby at Sandefjord where the cranes were being readied. They sat by the quay's edge, too big to be sheltered within any building. Now a blizzard struck, and it seemed impossible to continue work.

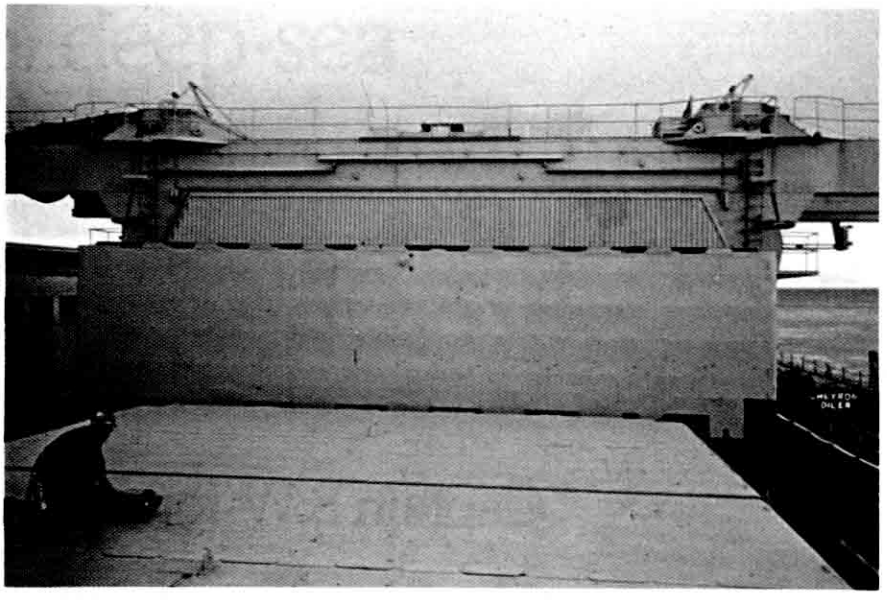
One night well after midnight we found Fredrik Munck, Olaf Marve, and their young design engineers all half-buried in the snow making their final electrical hookups under the glare of high floodlights. Soon Fredrik straightened up, his eyes glittering under ice-encrusted brows, and cried out, 'She's ready – I think. Let's go!' Nils Østberg climbed gingerly up into the cab, the first man to try all those controls. Clyde and Fredrik perched calmly on the spreader hanging below; they were going to imagine they were rolls of newsprint. In that position they could also be crushed if something went wrong.

'Take us up!' commanded Fredrik, and up they went ever so smoothly with Nils at the controls. 'Down again! Sideways! Now up and do it again!' She worked; out there in the night and howling snow, by God how she worked! We jumped and cried like madmen; then we all grabbed Fredrik and pitched him into the nearest snowbank.

Next morning came tugboats with Framnaes' giant floating crane to lift the first Munck crane onto the *Besseggen*. Heavy crane rails were installed at each side of the ship so the cranes could roll themselves along the full length of the deck straddling the hatches. It was a tense moment; the ship with its crane rails had been built in one place and the cranes in another. Measurements had been carefully compared and the work done with precision. But great structures such as these can expand, contract and move in response to their own environment, and yet they had finally to fit together within very close tolerances.

Slowly the crane was lifted high in the air over the waiting ship. We stood directly underneath to show our nonchalance. Down she came, very slowly, the workmen now pushing hard to swing her wheels clear of the hatch coamings close by. The wheels touched the rails; they fit. Clyde looked at me in wonderment: 'Did you see that? It fits!' 'Of course,' said I, sweating.

Fredrik had a publicity photographer standing by. Now he called to us, 'Do it again, only this time faster for the movie camera.' I will not record here how we answered him.



Gantries are designed to run over hatch covers in open position. (MacGregor)

Kaldnes, Framnaes and Munck, working hard together in that frozen bay of Sandefjord, finished their work and the *Besseggen* was formally delivered over to Chris Østberg on December 31, 1962. The second ship, *Rondeggen*, followed along more easily as the weather improved.

On a grey morning in February 1963 Phil Spaulding and I waited on the pier at Elk Falls, British Columbia. The *Besseggen* was coming in to load newsprint on her maiden voyage. Nils and Clyde were riding her; they waved to us from her forecastle.

Bow and stern lines were made fast and we hurried aboard. The mate worked a lever and the hatch covers opened wide. Longshoremen climbed up into the crane cabs, lifted the clamps and settled them down over eight-roll clusters of newsprint assembled at the dockside. From the cabs they threw switches and closed the grabs securely around the rolls, then swung them up and over into the cargo holds. It looked easy now. There were shortcomings here and there, but they could be fixed.

Phil walked round the whole ship, taking it all in. Finally he threw his cigar over the side and turned to me: 'I think you have a ship here.'

What was accomplished? The price of your newspaper has not increased as much as it might have. A segment of the marine industry was rekindled, and some seamen and dock workers have kept their jobs. Better still, the nature of those jobs was changed from brute hand labour into that of skilled technicians. It is by people that progress is made in technology, and it is for people that such peaceful progress is made. For me, that is a sufficient cause.

Facing page

Besseggen *in operation at San Francisco; gantries in position over holds to be discharged; the rolls of paper are discharged (or loaded) without manual operation.* (MacGregor)