

Ground Zero

**A Reassessment of
the 1917 Explosion
in Halifax Harbour**

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Exploding Myths: The Halifax Harbour Explosion in Historical Context

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This chapter will examine from an historical standpoint the oft-stated claim that the event in Halifax Harbour in 1917 was the largest manmade explosion prior to the atom bomb.² This statement may or may not be true, depending on how one interprets "largest." Is "largest" defined by the quantity of explosive material involved, the radius of major damage, the total value of property destroyed, the number of people killed and injured, the force or "size" of the blast, or by some other measurable effect? Considering the above criteria, the 1917 disaster unquestionably qualifies as one of the worst non-nuclear explosions in history. However, given that it was only one of a long line of major explosion accidents, this claim cannot be substantiated without a systematic comparison with other incidents of a similar nature. Until now, no such attempt has been made.³

For example, two massive explosions—both involving munitions ships—occurred in northern Russia several months before the *Mont Blanc* blew up in Halifax Harbour. In 1921 a huge chemical explosion at Oppau, Germany, killed hundreds of people and caused widespread destruction not unlike that seen at Halifax four years earlier.⁴ In July 1926 the Lake Denmark Naval Ammunition Depot near Dover, New Jersey, was rocked by a series of colossal explosions, the first of which "completely demolished every unshielded building within a radius of 2700 feet [0.8 kilometres], and heavily damaged buildings as far away as 8000 feet [2 kilometres]."⁵ In October 1935 the explosion of an arsenal in Lanchow, China (about 1,000 kilometres [620 miles] east of Beijing), caused loss of life comparable to that which had occurred in Halifax and Dartmouth in 1917.⁶ During the Second World War, three major explosion accidents invite comparison with Halifax Harbour in magnitude and extent of damage. In sum, literally dozens of explosion accidents have occurred all over the world which mirror the Halifax Harbour explosion in causes and consequences, if not precisely matching it in scale.

A definitive ranking of the magnitude and severity of every major explosion accident on record would be a daunting task, given the unpredictable nature of explosive materials, the problem of quantifying blast effects after the fact, and the unique physical and geographical circumstances of each event. Only a detailed reconstruction of events through painstaking scientific and empirical analysis would yield satisfactory results. Such an undertaking is beyond the scope of this chapter, and indeed may not be feasible. Even contemporaneous investigations usually focused on immediate causes rather than the physical properties of the blast.⁷ A universal characteristic of major explosion accidents is the absence or incompleteness of information necessary

to determine precisely what went wrong, because the event itself destroys so much crucial evidence and kills those closest to the site of the accident.

Unlike scientists, historians are accustomed to working with incomplete data. Although evidence sufficient to prove irrefutably that one explosion was physically "bigger" than another may be lacking, it is possible to identify major explosion events which share certain commonalities with the disaster in Halifax Harbour. The cases listed in the Appendix were selected because they satisfied at least one of the following criteria: they occurred in or near an urban area and resulted in significant civilian casualties or property damage, or they involved large quantities of munitions. Explosion accidents which have occurred in Canada were also noted. Since the Halifax Harbour explosion was technically a "marine" disaster involving the transport of explosive materials, particular attention was paid to transportation and shipping-related accidents.

Of the approximately 130 major explosion accidents listed for the period 1899 to 1976, only one in four occurred while explosive materials were being transported from place to place. Halifax Harbour thus emerges as something of an anomaly during the First World War, when explosion accidents were more common at munitions plants. For the entire period, more than 40 percent of the explosion accidents listed occurred during manufacturing, whereas one out of three occurred in a storage facility, such as a magazine or warehouse. By the Second World War, the number of industrial explosion accidents had fallen sharply thanks to increased automation, but the frequency of mishaps during storage and transport remained constant well into the postwar period.

The information gathered for this chapter supports the contention that no other accidental explosion in this century matches the dimensions of that at Halifax Harbour in 1917, but only so long as five criteria—the total number of casualties, area of devastation, sheer force of the blast, value of property destroyed, and quantity of explosives involved—are taken into account. If each factor is considered independently, a handful of explosions are of sufficient magnitude to justify detailed comparison with Halifax Harbour. They are: (1) Bakharitz, Russia (1916); (2) Ekonomia, Russia (1917); (3) Bombay, India (1944); (4) Port Chicago, California (1944); and (5) Hanbury, England (1944).

All five explosions resulted in extensive property damage, and four of the five occurred on munitions ships. Although the Hanbury site was located underground in a sparsely populated area, it warrants inclusion because of the huge quantity of munitions involved.

The Evolution of Explosives

Accidents involving black powder (or "gunpowder") have occurred for centuries.⁸ Black powder is classified as a deflagrating, or "low," explosive which is slow acting and relatively insensitive to mild shocks or friction. When ignited in open areas, its blast effect is minimal; but it burns at fairly low temperatures, and its explosive potential increases dramatically in confined spaces.⁹ The largest accidental explosion on record involving black powder

occurred at a factory in Pleasant Prairie, Wisconsin, in March 1911, when 550 tons exploded at once. Windows were shattered "at 3 miles [4.8 kilometres] in one direction and at 80 miles [129 kilometres] in another," but only one fatality was reported.¹⁰

It was only after the discovery of substances such as nitrocellulose (or "guncotton"), nitroglycerine, picric acid, and trinitrotoluene (TNT) in the late 1800s that explosives reached a new level of destructive force and deadliness. The so-called "dynamites" were much more volatile than black powder—in fact, guncotton, an early form of dynamite, was eventually banned in most countries because of the frequency of mishaps that had occurred during its manufacture.¹¹ Later on, the development of nitroglycerine proved no less dangerous; however, nitroglycerine became so popular that safer methods of handling and storing it were introduced. By the turn of the century, "high explosives" (HE) such as picric acid and TNT had appeared. These explosives proved ideal for military use because they detonated rather than deflagrated, producing an instantaneous thermochemical reaction with a very high shattering effect. The extreme destructive potential of high explosives spawned more elaborate safety precautions in an attempt to minimize the risks associated with their manufacture, storage, and transport.¹² After the outbreak of war in 1914, the demand for high explosives skyrocketed, along with the incidence of accidents "in improvised installations with unexperienced personnel who worked under hazardous and uncomfortable conditions."¹³

The First World War

The number of major explosion accidents involving the manufacture, storage, and transportation of both high and low explosives during the First World War was astonishingly high. No less than forty-two major explosion accidents occurred in the United States alone between August 1914 and the middle of 1916.¹⁴ Though German sympathizers or saboteurs were immediately suspected, the hazards associated with handling explosive materials were more often the real cause. When the E.I. du Pont de Nemours & Company plant at Carney's Point, Delaware, suffered five explosions in less than forty-eight hours in January 1916, a company representative admitted that because the labour force was "100 times as great as when the European War broke out," many employees had "not been at the business long enough to acquire the experience" of older workers.¹⁵

Concerns about security and safety were combined in the operations of the Semet-Solvay Company plant just outside Syracuse, New York. Opened in April 1915, the sprawling complex covered 1,000 acres (400 hectares) and was surrounded by "fourteen miles [twenty-three kilometres] of protective fence" and eight watchtowers. Three hundred guards "carrying 38 caliber Smith & Wesson revolvers" and "trained in the technique of fighting munition [sic] fires" patrolled the property around the clock. On the night of July 2, 1918, a fire broke out in the No. 1 TNT building, caused by an overheated gear in the

grinding machine used to mix acids with toluene. Soon after, about one ton of TNT exploded, killing thirteen guards and fifty workers; fifty others were critically injured. The explosion could have been much worse: in nearby plant magazines, 400 tons of TNT remained unscathed.¹⁶

Munitions works were often subdivided into many smaller buildings in order to minimize the damage from a single explosion—a practice which undoubtedly saved many lives. Nevertheless, fatal accidents continued to occur. Just before the First World War ended, the T.A. Gillespie Company in Morgan, New Jersey, touted as the largest and most modern munitions plant in the world, suffered a series of terrific explosions that destroyed 6,000 tons of ammunition and wrecked more than 300 buildings. The initial blast, the cause of which was never determined, occurred in one of the thirteen loading houses. A much larger secondary blast exploded 500 tons of nitrate and left a crater ten metres deep. The death toll approached one hundred, with a like number injured.¹⁷

In England, at least fifteen major explosion accidents struck the munitions industry in 1917 alone.¹⁸ Like in the United States, most British munitions plants were situated well away from densely populated areas. An exception was the factory at Silvertown, Essex, on the eastern outskirts of London, where an explosion on January 19, 1917, devastated a six-acre (2.4-hectare) area and killed eighty people.¹⁹ The French had their share of explosions as well. At Neuveville-sur-Saône, for example, a "fearful explosion" demolished a munitions plant on December 14, 1917, one week after the *Mont Blanc* blew up in Halifax Harbour. The blast was heard eighteen miles away. Most of the 350 workers in the factory were Chinese, Vietnamese, or Greek; no casualty figures were released because of wartime censorship.²⁰

The Germans and their allies, of course, were also running the risks of munitions production on a massive scale. Although British press coverage of civilian accidents in enemy territory was susceptible to jingoism, the reports echo a pattern similar to what was occurring in Allied and neutral countries. In June 1917 a munitions plant in Bloeweg, Bohemia, was alleged to have blown up, killing 400 and injuring 625. A month later, another plant exploded near Berlin, resulting in 300 dead or wounded.²¹ Many other reports of a similar nature exist, although there may be some doubt as to their veracity.²²

The difficulty in corroborating these events from the western side of the Atlantic is illustrated by the following example. Some authoritative sources cite a very large explosion in 1917 at a place called "Steinfeld." Steinfeld (or "stony plain") probably refers to a region southeast of Vienna, Austria, which had been used for industrial and military purposes for many years.²³ Although few details are given, the sources claim that both the quantity of munitions destroyed and the area of devastation was greater than at Halifax.²⁴ Unfortunately, the Austrians have no record of such an explosion. Although a number of munitions-related accidents did occur in the Steinfeld region during the First World War, so far as can be determined, none approach the

dimensions of Halifax Harbour. The most serious accident of this kind in Austria occurred on September 18, 1918, at the Wöllersdorf munitions plant near Vienna, where an explosion and fire claimed the lives of 276 workers.²⁵

A sizeable percentage of the people killed and injured in munitions-related accidents were women. By the end of 1916, one of every five workers in the French munitions industry was female.²⁶ In Austria-Hungary, more than 500 munitions plants operated under the jurisdiction of the War Ministry, in which more than half of the workers were women by 1916.²⁷ Between April 1915 and July 1918, the number of male workers in British munitions plants "more than doubled while the number of females . . . increased tenfold."²⁸ In the last year of the war, it was reported that two million workers were engaged in munitions production in England, of which "one-third are women."²⁹

Casualties suffered as a result of munitions production were tolerated with the same sang-froid as military losses on the front lines. "The heroism of the battlefields has frequently been equaled by the ordinary civilian in the factory, whether man or woman," wrote one British observer.³⁰ When twenty-six women were killed and thirty injured at an undisclosed location in England, one year to the day before the *Mont Blanc* blew up, a terse official statement declared that "the effect of the accident upon . . . munitions output will be negligible."³¹ Accidental explosions were regarded as an unpleasant but inevitable side effect of weapons production. Nor was it good for home front morale—or the recruitment of scarce labour—to dwell on the gruesome details of munitions-related accidents.

A case in point was the explosion that destroyed a munitions factory in April 1917 at Eddystone, Pennsylvania, where more than a hundred workers, "most of them women and girls," lost their lives. The accident occurred in an area of the plant where 30,000 shrapnel shells were being assembled.³² In this instance, what transpired is best left undescribed. On the whole, reports of domestic accidental explosions in war industries avoided sensationalism and emphasized worker morale and the self-sacrifice necessary to ensure victory. If hyberbolic journalism did creep in from time to time, it was usually in connection with initial reports of casualty numbers, which were almost always inflated. More blatantly suspect were the vague reports of explosion disasters in far-off places, usually behind enemy lines, where casualty figures always seemed to run much higher than domestic mishaps. A healthy dose of skepticism does no harm when gauging the authenticity of such reports, but they cannot be discounted entirely, as the following examples attest.

Bakharitza and Ekonomia

By far the most devastating explosion accidents during the First World War besides that in Halifax Harbour occurred near the north Russian city of Arkhangel'sk (Archangel). Beginning in 1915, British, Russian, and neutral vessels ferried millions of tons of supplies into Russia via this historic White Sea port situated near the mouth of the Dvina River. More than 600 voyages

were made in 1916 alone; by the end of the shipping season, a staggering quantity of materials was stockpiled at Bakharitzta, just across the river from Arkhangel'sk, including "600,000 tons of munitions and general cargo" from Great Britain, "300,000 tons of munitions from France, and 350,000 from the United States."³³ At the stroke of noon on November 8, 1916, a terrific explosion ripped through the munitions ship *Baron Driesen*, followed shortly thereafter by a second explosion. It was said that Bakharitzta was "turned into a desert," a large area of docks and warehouses was completely destroyed, neighbouring villages were "razed," and "all schools [in Arkhangel'sk] were turned into hospitals."³⁴ A detailed account of the disaster appeared in a Russian émigré journal published in New York in 1950:

*The steamship Baron Driesen had arrived from New York with a cargo of explosives: 20 minutes before the explosion, 40 tons of this freight were discharged off the ship onto the wharf. In nearby warehouses and loaded on trucks, there were piles of shells, fuses, and thousands tons of various explosive or inflammable materials awaiting shipment south. Close to the wharf and on the river, there were 49 steamships which had come to Arkhangel'sk with supplies, many of which were also laden with explosives. Suddenly an enormous pillar of smoke and flame arose above the Baron Driesen and the vessel was literally blown to pieces by a terrible explosion. Massive pieces of its superstructure and decks were blown sky-high and strewn up to six kilometres [3.7 miles] away. Burning fragments rained down on trucks and depots; they, in turn, were set on fire and caused more explosions. . . . Explosion followed explosion, and in a few minutes Bakharitzta was turned into a "fire-breathing volcano." Entire trains loaded with ammunition were blown up, spreading shells all over the area, which burst either in the air or on impact with the ground. Burning boxes of cartridges were cracking like machine-guns and scattering bullets in all directions. Vessels berthed nearby were seriously damaged by heavy pieces falling down from the sky. The British steamship Earl of Forfar was sunk, and a French steamship alongside was severely damaged by fire. . . . It was absolutely impossible to fight the fires and explosions, and rescue efforts were directed at moving undamaged materiel away from the scene and in rendering aid to the wounded.*³⁵

This disaster's casualties, although not as severe as Halifax, were very serious indeed: 650 killed and 839 wounded. Most of the victims were dock and railway workers just sitting down to lunch. The value of munitions lost was in itself far greater than the total property losses in Halifax and Dartmouth. Thirty thousand tons of munitions—ten times the quantity on board the *Mont Blanc* and worth an estimated US\$40 million—were destroyed, along with US\$7.5 million in rubber, and 20,000 bales of cotton.³⁶ The "size" of the explosion (as measured by the quantity of material involved) was also possibly equal to or

greater than the *Mont Blanc*, since unloading had just begun and the *Baron Driesen* was a slightly larger vessel.³⁷ It remains unclear, however, whether the cargo of the vessel was entirely made up of munitions, what type of munitions they were, and where the second explosion originated.

An inquiry conducted by the Russian navy cast suspicions on the captain of the *Baron Driesen*, who happened to be German and who had left the vessel thirty minutes before it blew up, but no charges were laid because of lack of evidence, and to this day the cause of the Bakharitza explosion remains in doubt.³⁸

Incredibly, another major catastrophe struck the outer port of Arkhangel'sk just ten weeks later. On January 26, 1917, at Ekonomia, a naval station located some ten kilometres [six miles] north of the city centre, the 4,000-ton vessel *Semen Chelyuskin* blew up, killing or wounding "everyone within a radius of one kilometre."³⁹ Estimates of casualties range between 400 and 1,500.⁴⁰ According to William Barr, a geographer at the University of Saskatchewan, who examined Russian sources, "there was considerable loss of life and very serious damage to the harbour installations."⁴¹

The cause and effects of the Ekonomia disaster were an eerie harbinger of the explosion at Halifax Harbour:

During the unloading of the ice breaking steamship Cheliuskin, which had arrived at Ekonomia with 3,000 tons of picric acid, an explosion took place. According to the testimony of witnesses, a small quantity of the cargo accidentally spilled on the dock near an open hold. Due to some carelessness or from some accidentally occurring sparks, the cargo was ignited and fire instantly spread to the half-unloaded hold. In an instant a deafening explosion took place and a huge column of flame and smoke was raised over the ship. The Cheliuskin blew to pieces, some of which landed a kilometre from the ship's moorage. Heavy wreckage was strewn over the area and caused damage to ships standing nearby. The English steamship Bairopea and a tugboat were sunk, and the French steamship St. Andres and other ships were heavily damaged. Coastal depots and other installations were demolished and a fire began on the pier. According to information, more than 30 men were killed and up to 350 were wounded in this catastrophe. Losses amounted to approximately 50 million gold rubles and it was only thanks to the absence on shore of substantial munitions that this disaster did not take on the dimensions of the explosion at Bakaritsa.⁴²

The two explosions near Arkhangel'sk obviously have many similarities to that at Halifax Harbour. In all three cases, munitions ships were involved; in the case of Ekonomia at least, the catalyst was an on-board fire, like that on the *Mont Blanc*. The likelihood that either of these events surpassed Halifax Harbour in all respects—loss of life and injury, value of property damage, area of devastation, and explosive magnitude of the blast—seems unlikely. Yet

many questions remain. What type of explosives caused the Bakharitza disaster and what were the precise quantities involved in both blasts? Why do the casualty figures differ markedly in various accounts?⁴³ Was the Bakharitza explosion really an act of sabotage or was this merely an explanation convenient for the authorities responsible? Without further research, we may never know the answers.

It should be clear by now that the explosion in Halifax Harbour was far from an isolated incident; accidents of this kind during the First World War were frequent and extremely destructive. In scores of localities all over the world, munitions were being manufactured in large industrial plants on an unprecedented scale.⁴⁴ The number of accidents is indicative not only of the volatile properties of the substances being made, but also of the extraordinary risks taken by workers to achieve high levels of production.

The American press did much to focus world attention on Halifax Harbour through its almost obsessive coverage in the days and weeks that followed the disaster. New Englanders were especially attuned to the dangers of making and transporting munitions, since most explosion accidents in the United States up to that time had occurred in the industrial states of New York, New Jersey, Pennsylvania, Ohio, and Delaware. Factories belonging to the du Pont company had a particularly abysmal safety record during this period.⁴⁵

Indeed, more than a year before disaster struck Halifax and Dartmouth, New York City had experienced a similar incident. On July 30, 1916, several barges loaded with dynamite manufactured in Pennsylvania by Bethlehem Steel caught fire while berthed at Black Tom Island, across the Hudson River from the island of Manhattan.⁴⁶ The resulting explosions destroyed thirteen warehouses in Jersey City and caused \$30 million in property losses, including extensive damage to buildings in Manhattan.⁴⁷ Miraculously, only six people were killed. The railway agent and dock superintendent were immediately arrested and charged with manslaughter. Municipal officials responded by ordering a visual inspection of "every freight train coming into Jersey City."⁴⁸ Any explosives uncovered during the search were to be removed before the train could enter the city. Subsequently the railway and port authorities were exonerated, whereupon the search for a scapegoat intensified. Although no one was ever prosecuted for deliberately setting the dynamite barges ablaze, sabotage was eventually proven to have been the cause of the Black Tom Island explosion.⁴⁹

New Yorkers undoubtedly recalled Black Tom Island when they read about Halifax Harbour. Cultural affinity and geographical proximity aside, it seems plausible that a heightened awareness of major explosion accidents influenced how the New England press portrayed the disaster in Nova Scotia. Moreover, the American press would not have felt the same constraints about covering a foreign disaster as would have been the case had it occurred in the United States. In Britain, too, wartime censorship had generally played down domestic explosion accidents involving munitions.⁵⁰ From both British and

American standpoints, the Halifax disaster was a sober reminder of what could happen without adequate precautions and vigilance, yet it was remote enough that its effect on civilian morale was not a major concern.

The Second World War

With the outbreak of war in 1939, munitions production resumed on a massive scale. Concomitant with these activities was the greatly increased probability of accidents. In addition to private firms such as the huge Vickers Armstrong company, and the historic munitions works at Woolwich, Enfield, and Waltham, the British government built forty "Royal Ordnance Factories" (ROF), which employed more than 300,000 workers by 1942.⁵¹ Given the high number of accidents at munitions plants during the First World War, it is remarkable that only 134 fatalities were recorded at ROF factories during the war. These statistics do not, however, include the hundreds of privately owned companies that made arms, explosives, and various hazardous chemicals as part of the British war effort.⁵²

Although the record of explosion accidents during manufacturing improved somewhat, the transportation and storage of munitions brought a different story. Almost all the major explosion accidents of the Second World War took place in storage areas or during transshipment. Merchant vessels by the end of the war were capable, on average, of carrying much larger cargos than their First World War counterparts, so the need to observe proper safety procedures, especially while in port, should have commanded the utmost vigilance. On two tragic occasions in 1944—in Bombay, India, and Port Chicago, California—this was not the case.⁵³ The third major munitions accident of that year—and possibly the largest accidental detonation of conventional explosives in this century—was also probably the result of human carelessness. Had it occurred in a densely populated area, the explosion of November 27th would almost certainly have eclipsed Halifax Harbour in every respect. Fortunately, it took place in an abandoned gypsum mine twenty-seven metres (ninety feet) below the English countryside.

Bombay

The British vessel *Fort Stikine*, loaded with munitions, blew up in Bombay harbour on April 14, 1944.⁵⁴ One of twenty-six cargo vessels built in Canada with U.S. funds and turned over to Britain under the Lend-Lease program, the *Fort Stikine* borrowed her name from a river in British Columbia. She was launched at the Prince Rupert Dry Dock in the fall of 1942.⁵⁵

Many parallels exist between Halifax Harbour in 1917 and Bombay harbour twenty-seven years later. Both the *Mont Blanc* and *Fort Stikine* were carrying cargoes that made them particularly hazardous; both failed to observe basic safety regulations, which were either ignored or waived because of wartime exigencies; and both began with a seemingly innocuous fire on board ship that, under different circumstances, might well have been quickly brought under control.

The fateful catalyst on board the *Fort Stikine* was 9,000 bales of raw cotton. During the war there had been more than sixty shipboard fires in Bombay harbour, one-quarter of which involved munitions transports.⁵⁶ In the months leading up to the disaster, only one vessel had been lost, but several fires in harbour had started on ships laden with Karachi cotton, which is highly prone to spontaneous combustion. With cotton prices tumbling because of mounting stockpiles of raw cotton in the north, the Indian government desperately sought means to replenish the mills in the south after rail transport was curtailed in 1944. The only way to do so was by water, and munitions ships were pressed into service as carriers of general cargo—a practice strictly prohibited under ordinary circumstances.

On the rare occasions when a munitions ship entered a port in peacetime, a red flag was always hoisted as a warning to others that she should be given a wide berth. In wartime, however, this could have fatal consequences if enemy aircraft spotted the signal. Masters of ships carrying munitions "had grown wary" by 1944. "Not wishing to advertise the fact that their ships were the most worthwhile targets, they had got into the habit, with the blessing of everybody around them, of keeping their red flags neatly folded and stowed out of sight."⁵⁷ When the *Fort Stikine* sailed into Bombay harbour on April 12th, only a handful of port officials were aware of her deadly contents.

The first sign of trouble was smoke, seen billowing from the ship's ventilators. Several hours passed before the gravity of the situation became apparent. By the time firefighting efforts were organized, the heat and smoke below decks made inspection impossible. As a result, millions of gallons of water were poured into the holds with no noticeable effect, since no one could tell where the fire was concentrated. Only a later reconstruction of events from eye-witness accounts and an analysis of where the cargo had been stowed revealed the irony of what was happening:

*The fire was in the top layers of the cotton bales, tight against the port side of the hold. As the water poured in, well to one side of the seat of the fire, the cotton began to float. There was an empty space, seven feet high, between the cotton and the magazine of explosives in the 'tween decks above. Slowly the level of water rose in the wide hold. And as it rose, so the fire, held clear of the water as more and more bales floated up beneath it, drew gradually nearer to the explosives until a fierce heat began to play directly under the magazine.*⁵⁸

The clock stopped at six minutes past four in the afternoon when the *Fort Stikine* blew apart, unleashing a firestorm of blazing cotton bales, incendiary bombs, and drums of burning lubricating oil, all raining down in a two-kilometre radius. At an adjoining berth, the 4,000-ton *Jalapadma* was lifted out of the water, pivoted ninety degrees, and dropped onto the roof of a fifty-foot-high dockside shed. Thirty-four minutes later, a second, even bigger explosion

rocked the city as 784 tons of explosives in No. 4 hold, in what was left of the *Fort Stikine*'s stern section, detonated. The quantity of munitions and the force of the blast was twice as large as the first explosion.⁵⁹

Like the Port Chicago explosion three months later, the initial reaction of many was that the Japanese were bombing the port.⁶⁰ The effect was certainly reminiscent of Pearl Harbor: "Eleven vessels were on fire, and four sunk. Others were aground, listing and damaged. Dock gates, bridges and berths were destroyed, sheds, warehouses and offices were demolished and the ruins [were on fire]; roads, railways and equipment [were] a mass of tangled wreckage."⁶¹ Like Halifax Harbour in 1917, determining the precise number of casualties with any degree of certainty was impossible, particularly in a city swollen with refugees and migrant war workers. The official estimate was 1,376 killed and many thousands injured, but "the true overall figure was far higher."⁶²

Inadequate safety precautions were the chief cause of the disaster. Before the war, the standard procedure for ships carrying dangerous cargo was to have them offloaded into lighters some distance from the waterfront. During wartime, however, when ships needed to be turned around quickly so they could all sail together in convoy, this practice had been discontinued. In any case, the number of lighters available simply could not keep pace with the increased volume of traffic brought on by the war. Furthermore, many vessels carried heavy cargo on their decks that had to be removed by dockside cranes before access to the holds below was possible.⁶³ Aboard the *Fort Stikine*, for example, crated gliders were stowed on deck. In contravention of port regulations, the ship was berthed in a part of the harbour crowded with other vessels and adjacent to a heavily populated section of the city. Also against regulations, it sat there a full twenty-four hours before unloading operations began.

In the chaos that followed the initial explosions, the civilian population suffered greatly because authorities had no prearranged plan to cope with such an emergency.⁶⁴ The devastation extended beyond the surrounding docks and into a nearby residential district, where much of the property damage was caused by fires touched off by flying debris. Eventually, more than 3,000 persons would file claims for fire damage, and nearly 12,000 submitted claims for uninsured property.⁶⁵

Port Chicago

The week of July 17, 1944, was an eventful one in the chronology of the Second World War. In Tokyo, General Tojo resigned as prime minister on the announcement of the fall of Saipan, and on Thursday the 20th, Adolf Hitler narrowly escaped death from an assassin's bomb. On Tuesday, however, all eyes on the American home front were diverted to a small town not far from San Francisco, California. At 10:19 p.m. the night before, a terrific explosion had wrecked the naval base at Port Chicago. The Liberty ship *E.A. Bryan*, fully

loaded with a cargo of ammunition and high explosives, had erupted in a blinding sheet of flame. More than 300 American servicemen were killed; most of them Black sailors employed in shiploading operations.

It was described as the worst explosion accident in U.S. history.⁶⁶ Windows shattered in buildings thirty kilometres (nineteen miles) distant. The earth shook in San Francisco, some fifty kilometres (thirty miles) away. Every building within a radius of five kilometres (three miles) was either "razed or damaged." In Port Chicago, two kilometres (1.2 miles) from ground zero, an off-duty crewman was nursing a drink at the local bar. The concussion broke the glass in his hand and threw him across the room. Nearby, about 200 movie patrons sat "watching a war film filled with bombing scenes." With a deafening roar, the west wall of the theatre suddenly caved in. Luckily, the roof did not collapse and everyone inside escaped serious injury.⁶⁷

At first, many people in the vicinity attributed what had happened to an air raid by the Japanese. Further away, in San Francisco and down the coast, it was believed that an earthquake had struck. Ironically, preparations for earthquakes meant disaster relief at Port Chicago was much better organized than at Halifax or Bombay.⁶⁸ Perhaps this contributed to the relatively low casualty rate, which was limited primarily to those servicemen who were loading munitions, and their supervisors. What caused the accident was never determined. As one naval spokesman put it: "We have no basis for giving [a cause] . . . as there are no close survivors to give evidence of what happened." Soon after the disaster, however, some officials inferred that a discarded cigarette might have been at fault. It was reported that the Coast Guard had prosecuted twenty service personnel in the previous six months for smoking on munitions ships.⁶⁹

Others pointed the finger at the navy. A witness who watched sailors transferring 650-pound incendiary bombs from railcars to No. 1 hold on the *E.A. Bryan* shortly before the explosion observed that "the men were having some difficulty getting the bombs out of the boxcar because they were wedged in so tightly."⁷⁰ Contrary to regulations, the weapons were fused, making them "hot cargo." Many complaints regarding inadequate safety precautions were registered with naval authorities prior to the accident, and in fact most of the Black enlisted men who survived refused to resume their hazardous duties. This led to the largest mass mutiny trial in U.S. naval history.⁷¹

An interesting, if farfetched, theory was advanced some years ago that the Port Chicago explosion was caused not by conventional weapons but by an early prototype of the atom bomb. In a 1982 article, Peter Vogel argued that the United States had the capability to produce a nuclear device as early as the spring of 1944. He noted that the Port Chicago event was unlike Halifax or Bombay because the explosion was instantaneous, rather than the result of a fire. The blast was so destructive that it completely pulverized the *E.A. Bryan*—no identifiable remnant of the ship was ever found. Some eye-witnesses reported seeing a bright flash of "brilliant white"—characteristic of a nuclear

fission bomb. Another well-known feature, the mushroom cloud, was also present at Port Chicago, being variously described as a huge "smoke ring" or "flaming doughnut."⁷² However, this phenomenon was also present in other non-nuclear explosion events; eye-witnesses reported seeing the same cloud formation in the Hanbury (Fauld) explosion in England, some four months later.⁷³ These counter-arguments and a general lack of evidence eventually led Vogel to abandon his atom-bomb theory.

In terms of its comparability to Halifax Harbour, Port Chicago is probably the weakest contender of the three 1944 explosions. Although the quantity of munitions on board the *E.A. Bryan* was nearly as great as the cargo of the *Mont Blanc*, the explosion did not inflict a comparable degree of property damage, nor were the casualties nearly as numerous. Yet the range of major structural damage—extending to the town, two kilometres away, and beyond—indicates an explosion of enormous magnitude. The low casualty rate and lack of material damage may be attributed as much to the isolated locale of the base as to the "size" of the blast. Scientific analysis of seismic data could possibly shed more light on how the Port Chicago blast wave compared with that of Halifax Harbour.

Hanbury (Fauld)

Probably the largest blast before Hiroshima, in terms of quantity of explosives and sheer force, occurred in a gypsum mine in the Stone Pit Hills of central England. This obscure event, little known outside England, is variously called the "Fauld" explosion (after the Royal Air Force [RAF] ammunition depot where the accident occurred), the "Burton upon Trent" explosion (after the closest major town), or the "Hanbury" explosion (after the tiny village less than two kilometres [1.2 miles] from the site). The latter designation is preferred because it links the event with the community which sustained the brunt of damage.

Hanbury is famous for its vast alabaster caverns. Even today the largest gypsum deposits in Europe continue to be mined there.⁷⁴ In 1938 the RAF began storing bombs in disused parts of the mines. At ten minutes past eleven on the morning of November 27, 1944, a huge explosion occurred about thirty metres (one hundred feet) underground. None of the twenty-six soldiers and Italian labourers in that section of the mine survived. Some forty others were killed, as were about 200 head of cattle grazing on meadows above.

From the visible evidence, and contemporary reports of what happened, it seems likely that this incident exceeded Halifax Harbour in explosive magnitude. At Daventry, one hundred kilometres (sixty-two miles) away, it was reported that people "ran into the streets, thinking there had been a bomb explosion nearby."⁷⁵ The seismic event was detected on instruments in Geneva, Rome, and as far away as Casablanca.⁷⁶ At the West Bromwich observatory, fifty kilometres (thirty-one miles) from Hanbury, a "violent earth tremor" lasting three minutes was recorded; a scientist there said it was the

"heaviest explosion I have experienced in 36 years."⁷⁷ A crater nearly 300 metres (980 feet) across and 24 metres (80 feet) deep gave dramatic indication of the desolation below ground. It was estimated that the explosion ejected "three million cubic yards (2.3 million square metres) of earth and rock . . . and deposited [it] over an area of a square mile around the crater." RAF photographs taken soon after the event reveal a moonscape pockmarked by hundreds of secondary craters caused by falling debris and gases filtering up through the soil.⁷⁸

German propaganda claimed responsibility for the explosion, and there was much public speculation that either they or the Italian "co-operators" brought in to work from a nearby P.O.W. camp were somehow responsible.⁷⁹ Rumours even circulated that an "American super-bomb" had gone off in the mine.⁸⁰ Although the cause of the explosion was never determined, a military court of inquiry found "evidence of negligence on the part of those who had the responsibility for maintaining safe working conditions underground."⁸¹ At the time, the ammunition dump was being used by the air force to "refurbish" unexploded bombs that had been jettisoned by aircraft returning from missions over Germany.⁸² One worker who left the mine minutes before it blew up told investigators that he saw someone chipping away at a broken detonator with a brass chisel, contrary to strict regulations. Whether mishandling of unexploded bombs or lax supervision were direct causes of the tragedy or not, a contributing factor had to be the decision to concentrate such huge quantities of munitions in one place. Clearly, the hard lessons of two wars and a multitude of accidents had not been learned.

The Hanbury explosion challenges Halifax Harbour on just one score: the tonnage of explosives detonated and the resulting force of the blast. Based on the known total quantity stored at the site on the day of the explosion, subtracted from the amount recovered later for disposal, it is estimated that between 3,500 and 4,000 tons were detonated, most of which consisted of 4,000-pound HE bombs.⁸³ This would have eclipsed the 2,900 tons of picric acid, TNT, and other explosives on board the *Mont Blanc*. In addition, the seismic evidence suggests a blast of very great magnitude, although comparisons with Halifax Harbour would be difficult since the latter explosion occurred over water as opposed to underground.

To this day, the Ministry of Defence has rejected all proposals to reclaim the land.⁸⁴ The local county council once planned to turn the crater into a municipal dump, but outraged relatives of blast victims whose bodies remain buried there blocked the proposal. For many years, at the bottom of the crater, two small alabaster crosses kept lonely vigil over "a hallowed grave."⁸⁵

Epilogue (and Prologue?)

So many natural and human-caused disasters have taken place since the First World War that the enduring fascination with the 1917 Halifax Harbour explosion is rather puzzling. Halifax Harbour pales in the aftermath of

Hiroshima, Nagasaki, Chernobyl, Bhopal, and other latter-day catastrophes. No doubt there is truth to the notion that the Halifax Harbour explosion is promoted to some extent as a "world-class" historical event for the benefit of tourists, who are invited to experience it vicariously through books, exhibits, and memorabilia. But there is more to the phenomenon than that. The obsession with pinpointing the precise moment of the blast, determining the exact amount of explosives involved, or fixing the true location of the *Mont Blanc* when she blew up implies a need to rationalize an event so uniquely destructive that it still defies comprehension. By taking note of the global record of communities and lives devastated by major explosion accidents, the process of demystifying the Halifax Harbour explosion—through a better understanding of how and why such incidents occur—can proceed.

In some ways the 1917 explosion will forever remain larger in myth than it ever was in reality. The death toll in the disaster was horrifying, to be sure, but at the time the terrible casualties of trench warfare had been filling headlines for more than three years. Moreover, as is clearly evident from the record of accidental explosions in the munitions industry during the First World War, hundreds if not thousands of civilian men and women on both sides of the conflict had lost or would soon lose their lives in accidents similar to the Halifax Harbour explosion. These incidents were not kept from the general public, but neither were they emphasized in the interests of preparedness.

There were ample forewarnings that a disaster in Halifax Harbour could occur—witness Black Tom Island, Bakharitza, and Ekonomia, to name but a few. The explosion came without warning because few people in Canada at the time understood the implications of the newly instituted convoy system, the chief effect of which was to clog the harbour with large numbers of merchant and naval vessels. Fewer still were aware that some of those vessels carried sufficient quantities of explosives to produce very destructive single explosions. Had there been greater awareness that remarkably similar disasters had already occurred elsewhere, Halifax and Dartmouth might have been spared the terrible consequences of ignorance.

The events of the First World War are commonly viewed as firmly locked in the distant past. It is surprising to realize that the conditions necessary for accidents similar to what happened in 1917 are still present today. In the Thames Estuary, just off the Kentish shore, lies the half-submerged hulk of the American Liberty ship *SS Richard Montgomery*. Still the property of the U.S. government, the wreck contains about 1,500 tons of high-explosive cargo, including large numbers of cluster bombs with fuses installed.⁸⁶ Explosives experts consider it so dangerous that they refuse to even consider an attempt to neutralize the cargo.⁸⁷ The threat posed by the *Richard Montgomery* is growing with the passage of time, since local fishermen have adopted the careless habit of dumping old bombs caught up in their nets into the waters beside it.⁸⁸ This marine relic speaks volumes about the real and present danger

that past explosion accidents may be repeated. It also points to the ongoing need for education and vigilance as long as deadly explosives remain in our midst.

Conclusion

Depending on how one interprets size, there are several possible candidates for the largest non-natural explosion prior to the atom bomb. Halifax Harbour remains unchallenged in overall magnitude as long as five criteria are considered together: number of casualties, force of the blast, radius of devastation, quantity of explosive material, and total value of property destroyed. But there is cold comfort in making such an unenviable claim. When placed in historical context, the explosion in Halifax Harbour must be seen not so much as a unique tragedy visited upon an unsuspecting city, but as one particularly violent occurrence in a long continuum of catastrophic explosion accidents. All were predictable; nearly all were preventable. Most were the product of a volatile mixture of human fallibility and ever-increasing quantities of extremely destructive substances. The preconditions for extending that continuum into the future unfortunately still exist.

Appendix: Major Accidental Explosions*

Date	Location	Type and quantity	Extent or radius of damage & casualties	Cause(s)
5 March 1899	Lagouban naval magazine, Toulon, France	powder magazine; 50 tons black powder	3 km radius; 50 killed	spontaneous combustion
10 September 1905	Rand powder mill, Fairchance, Pennsylvania	powder factory	19 killed	
11 September 1905	Japanese battleship <i>Mikasa</i>	magazine explosion	250 killed, 350 injured	fire of unknown origin
28 November 1906	Witten, England	explosives works; Roburite	28 killed, 200 injured	
12 March 1907	French battleship <i>Iena</i> , Toulon Navy Yard, Toulon, France	magazine explosion	103 killed, 150 injured	spontaneous combustion of cordite
2 May 1907	Canton, China	gunpowder magazine	"tremendous damage"; 20 killed	
16 October 1907	E.I. du Pont de Nemours & Co. Powder Mills, Fontanet, Indiana	powder factory	6.5 sq. km., \$800,000 damage; 38 killed, 18 injured	
8 May 1910	Hull, Quebec	explosives factory; potassium chlorate, 9,000 lbs. explosives	"all trees within radius of two miles were totally destroyed . . . many houses were razed to the ground."	fire in plant where special explosive using potassium chlorate was being made; spectators at nearby football game gathered to watch blaze; many casualties resulted
1 February 1911	Communipaw Terminal, New Jersey	dynamite; 40 tons	30 killed	
9 March 1911	Pleasant Prairie, Wisconsin	three explosions at black powder factory; 12 tons b.p., 550 tons b.p., and 14 tons b.p./35 tons dynamite	"Damage very serious within two miles of factory"; one killed	first explosion occurred in glazing department, cause unknown
23 September 1911	French warship <i>Liberté</i> , Toulon, France	magazine explosion	235 killed, 160 injured	unknown (sabotage suspected)
7 March 1913	SS <i>Alum Chine</i> , Baltimore, Maryland	commercial explosives; 300 tons dynamite	60 killed	fire initiated by coal gases
26 November 1914	HMS <i>Bulwark</i> , Sheerness, England	magazine explosion; 1,200 tons	all but 14 of nearly 800 officers and men perished	
9 March 1915	Antwerp, Belgium	arsenal	14 killed, 70 injured	
13 April 1915	Admiralty store, Lerwick, Shetland Isles	naval magazine	a "terrible" explosion, "Harbor Street was wrecked"; 7 killed, 20 wounded	fire
27 May 1915	HMS <i>Princess Irene</i> , Port Victoria, Isle of Grain, England	mines during shiploading operations	400 killed	fire
20 October 1915	Paris, France	munitions plant	52 killed	
30 November 1915	Lower Hagley, Delaware, E.I. du Pont de Nemours & Co.	munitions plant	31 killed	

Date	Location	Type and quantity	Extent or radius of damage & casualties	Cause(s)
11 December 1915	Havre, Belgium	munitions plant	110 killed, 1,000 injured	
30 December 1915	HMS Natal, Cromarty Firth, Scotland	internal explosion	390 killed	unknown
6 February 1916	Skoda navy arsenal, Pilsen, Bohemia (Czech Republic)	arsenal; melinite	three factory buildings destroyed; 195 killed	
29 February 1916	New England Chemical Company, Woburn, Massachusetts	munitions plant		sabotage suspected
4 March 1916	Fort Double Couronne, St. Denis (Paris), France	magazine	30 killed	
21 April 1916	Bordeaux, France	black powder factory	30 killed	
2 April 1916	Explosives Loading Company (ELC), Faversham, Kent, England	black powder factory; 150 tons ammonium nitrate, 15 tons TNT	106 killed, 66 injured	sparks from boiler house ignited nearby shed filled with TNT and ammonium nitrate
25 April 1916	Dedeagatch, Bulgaria	black powder factory (German)		
1 May 1916	La Pallice, France	picric acid factory; 200 tons	170 killed	heat from fire in sifting workshop melted picric acid stored in barrels, forming calcium picrate, which then exploded
15 May 1916	Repauno Works, E.I. du Pont de Nemours & Co., Gibbstown, New Jersey	TNT plant	plant buildings "shattered" over 3,000-acre area, \$250,000 damage; 14 killed, 20 injured	unknown (fire suspected)
21 June 1916	Parry Sound, Ontario	shrapnel factory	5 killed, 20 injured	unknown
June 1916 (?) [see 11 December 1915]	Havre, Belgium	munitions plant	110 killed, 900 injured	
1 July 1916	Aetna Explosives Co., Emporium, Pennsylvania	black powder factory; "several thousand pounds of powder"	7 killed, 5 injured	explosion in drying house
30 July 1916	Black Tom Island, Jersey City, New Jersey	munitions barge; dynamite	13 warehouses destroyed, \$30 million damage, including \$1 million in broken glass on Manhattan Island; 6 killed	sabotage
8 August 1916	Koenigsberg, East Prussia	ammunition shipment	50 killed (including 20 women), 72 injured	

Date	Location	Type and quantity	Extent or radius of damage & casualties	Cause(s)
2 August 1916	Italian battleship <i>Leonardo da Vinci</i> , Taranto, Italy	magazine explosion	248 killed	fire of unknown origin (sabotage suspected)
20 August 1916	Drummondville, Quebec	munitions plant	8 killed, 20 injured	unknown
21 August 1916	Low Moor Bradford, Yorkshire, England	picnic acid factory	factory destroyed by series of explosions and fire; 39 killed.	iron picrate explosion suspected; low death toll due to fire giving warning of impending explosion
14 October 1916	near Lungkiang (Tsitshihar), Manchuria	munitions train	200 killed or wounded; 40 houses destroyed	overheated wheel axle on rail car
8 November 1916	SS <i>Baron Driesen</i> , Bakharitza, near Arkhangel'sk, Russia	munitions ship	damage included: 30,000 tons of munitions (valued at US \$40 million), \$7.5 million rubber, and 20,000 bales of cotton; docks and warehouses destroyed, neighbouring villages "razed"; 650 killed, 839 injured	sabotage alleged but not proven
20 November 1916	Battleship <i>Imperatritsa Maria</i> , Petrograd, Russia	magazine explosion	200 killed	fire
6 December 1916	England	munitions plant	26 killed, 30 injured (all women)	
15 December 1916	Felixdorf Co., Wiener-Neustadt (Steinfeld region, south of Vienna), Austria	munitions plant	"several buildings in the town" demolished; 14 killed, 77 injured	
11 January 1917	Canadian Car and Foundry Co., Kingsland, New Jersey	munitions plant	\$1 million damage	
26 January 1917	SS <i>Semen Chebyuskin</i> , Ekonomia, near Arkhangel'sk, Russia	munitions ship; ca. 1,500 tons	\$25 million damage; more than 500 killed or wounded	unknown
19 January 1917	Silvertown, Essex, England	explosives works	about 80 killed, 400 injured	
10 April 1917	Eddystone Munition Corp., Eddystone, Pennsylvania	munitions plant	30,000 shells destroyed; 112 killed (mostly women and girls)	
17 June 1917	Blumau, Steinfeld region, Austria	munitions dump; unspecified quantity of captured Italian ammunition	6 killed, 330 injured	
23 June 1917	Bloeweg, Bohemia	munitions plant	400 killed, 625 injured	fire
9 July 1917	HMS <i>Vanguard</i> , Scapa Flow, Scotland	internal explosion	1,000 killed	
6 August 1917	Henningsdorf, Germany (near Berlin)	munitions plant	300 killed or injured	
22 November 1917	Griesheim Company, near Frankfurt, Germany	chemical works	completely destroyed fourth largest chemical plant in Germany	

Date	Location	Type and quantity	Extent or radius of damage & casualties	Cause(s)
6 December 1917	Aetna Chemical Co., Heidelberg, Pennsylvania	munitions plant	10 killed	
6 December 1917	SS <i>Mont Blanc</i> , Halifax, Nova Scotia	munitions ship; 2,900 tons of picric acid and other explosives	1,800 killed	fire caused by collision of two vessels
5 April 1918	Blumau, Steinfeld region, Austria	munitions plant; picric acid	36 killed	
18 May 1918	Aetna Chemical Co., Oakdale, Pennsylvania (near Pittsburgh)	chemical works	100 killed, 300 injured	
1 July 1918	Chilwell, Nottingham, England	munitions plant	134 killed (including 25 women), 250 injured	
2 July 1918	Semet-Solvay Company, Split Rock, Onondaga County, New York	munitions plant	63 killed, 50 injured	fire caused by overheated gear in grinding machine
12 July 1918	Battleship <i>Kawachi</i> , Tokoyama Bay, Japan	magazine	500 killed	
3 August 1918	Hamont Station, Belgium	ammunition train	1,750 German soldiers killed	
18 September 1918	Wollersdorf, Austria (near Vienna)	munitions plant	276 killed, mostly girls; other reports claim as many as 400 killed	fire
4 October 1918	T.A. Gillespie & Co., Morgan, New Jersey	munitions plant; 500 tons HE (high explosives)	2 km; 94 killed	
14 October 1918	British Explosives Ltd., Trenton, Ontario	munitions plant	two buildings destroyed, every window in town of Trenton (3 km away) broken; 1 person killed	
1 February 1919	Longwy, France (near Belgium-Luxembourg border)	munitions train	64 killed	
10 August 1921	Hiroshima, Japan	powder magazine	100 killed	unknown
29 September 1921	Oppau, Germany	chemical works; 4,500 tons ammonium nitrate & ammonium sulphate	75% of village (pop. 6,500) destroyed; 561 killed, 1,500 injured	unknown
25 May 1922	Blumau, Austria	black powder factory	22 killed	
1 March 1924	Nixon Nitration Works, Nixon, New Jersey	explosives works; TNT	"buildings shaken 50 miles away"; 26 killed, 100 injured	residual TNT from "recycled" artillery shells; death toll low because it was a Saturday
28 May 1924	Cotocreni ammunition depot, near Bucharest, Rumania	ammunition depot	\$2.6 million damage; 40 killed	
27 December 1924	Oturu, island of Hokkaido, Japan	explosion in harbour; dynamite	"city badly wrecked"; 120 killed, 200 injured	
28 February 1925	Caju Island, Brazil (near Rio de Janeiro)	government arsenal; 40 tons black powder	8 dead, 600 injured, 300 "unaccounted for"	two lighters anchored nearby caught fire, which spread to storage sheds
1 March 1925	Kharput, Turkey	magazine	160 killed, including 100 Kurdish rebels	possibly deliberate

Date	Location	Type and quantity	Extent or radius of damage & casualties	Cause(s)
25 May 1925	Mukden Arsenal, Beijing, China	arsenal	buildings "a thousand yards distant" were "demolished"; 300 killed or injured	unknown
7 April 1926	Mannheim, Germany	black powder factory	40 killed, 50 injured	
10 July 1926	Lake Denmark Naval Ammunition Depot, near Dover, New Jersey	magazine; 500 tons TNT in primary explosion, 300 tons in two secondary explosions	Picatinny Arsenal, an army base about 1.6 km away, was "practically wiped out"; estimated \$75 million damage; 21 killed	fire caused by bolt of lightning; death toll low because it was a Saturday
12 August 1926	Manfred Weiss factory, Csepel (near Budapest), Hungary	munitions plant	24 killed, 300 injured	
29 July 1928	Fuks & Hagria factory, Lodz, Poland	chemical works	40 killed, 100 injured	
26 September 1928	Fort Cabreriza, Morocco	powder magazine	38 killed	
4 March 1929	Sofia, Bulgaria	arsenal	28 killed, 12 injured	
5 September 1929	Brescia, Italy	black powder factory	22 killed	
30 April 1931	Nichteroy (near Rio de Janeiro), Brazil	munitions plant; 75 kg TNT	100 killed, 300 injured	unknown; workmen were attaching warheads to torpedoes
5 May 1931	Yuchu Fortress, near Canton, China	arsenal	100 killed	unknown
13 August 1931	Macao, China	ammunition depot	26 killed, 32 injured	
10 July 1932	Nanking, China	ammunition depot	100 killed	
20 January 1933	Morelia, Mexico	dynamite	23 killed	
14 March 1934	La Libertad, El Salvador	magazine	250 killed	
13 June 1935	Westphalian & Anhalt Explosive Works, Reinsdorf (suburb of Wittenburg), Germany	munitions plant	102 killed, 723 injured	"untrained workers"
26 October 1935	Lanchow, China	arsenal	2,000 killed	
18 March 1937	New London, Texas	gas	413 high school students killed	faulty radiator filled school with odourless gas; which was ignited by a spark of unknown origin
29 August 1940	Bologna, Italy	munitions plant	38 killed	
12 September 1940	Hercules Powder Company, Kenil, New Jersey	black powder factory	49 killed, more than 200 injured	
10 January 1941	Polichka, Eastern Moravia, Czechoslovakia	munitions plant	80 killed	

Date	Location	Type and quantity	Extent or radius of damage & casualties	Cause(s)
4 May 1941	SS <i>Malakand</i> , Liverpool, England	munitions ship	unknown	fire caused indirectly by German air raid
9 June 1941	Fort Smederovo, Smederovo (near Belgrade), Yugoslavia	Serbian ammunition dump	1,500 killed, 2000 injured	deliberately detonated by partisan guerrillas
5 June 1942	Elwood Ordnance Plant, Joliet, Illinois	munitions plant	54 killed, 41 injured	
21 July 1942	Limbourg Province, Belgium	chemical works	200 killed, 1,000 injured	
17 September 1943	Norfolk, Virginia	ammunition shipment	24 killed, 250 injured	
2 December 1943	USS <i>John Harvey</i> , Bari, Italy	munitions ship carrying ammunition and 100 tons of mustard gas	more than 1,000 killed, mostly Italian civilians	fire
14 April 1944	SS <i>Fort Stikine</i> , Bombay, India	munitions ship; 1,500 tons ammonal	1.6 km; 1,376 killed	ignition of guncotton by spontaneous combustion or discarded cigarette
20 April 1944	unidentified German vessel, Bergen, Norway	munitions ship	4 km; 200 killed, 2,000 injured, 4,000 homeless	munitions carrier accidentally torpedoed by German sailors
4 July 1944	Aarhus, Denmark	German munitions ship	US \$20 million property damage; 80 killed, 300 injured	unknown
17 July 1944	SS <i>E.A. Bryan</i> , Port Chicago, California	munitions ship; 2,100 tons	10 km; 320 killed	unknown
20 October 1944	East Ohio Gas Company, Cleveland, Ohio	liquid natural gas storage tank	\$6 million property damage, 1.6 sq. kilometres; 130 killed	
2 November 1944	Ivry (Paris suburb), France	two trains carrying captured German ammunition	27 killed, 95 injured	unknown
27 November 1944	RAF Pauld, Hanbury, Staffordshire, England	Royal Air Force munitions depot; 3,500-4,000 tons HE	70 killed	unknown; possibly mishandling of unexploded bombs
26 February 1945	Paris, France	munitions dump	20 killed	
9 April 1945	unidentified U.S. vessel, Bari, Italy	munitions ship	360 killed, 1,730 injured	
7 July 1945	Zaragoza (Saragossa), Spain	powder magazine	30 killed, 32 injured	
25 October 1945	Asniers-en-Bessin, France	ammunition dump	33 killed	
29 December 1945	Codroipo, Italy	ammunition dump	23 killed	
8 April 1946	Saigon, South Vietnam	ammunition dump	20 killed	
18 August 1946	Vergarola, Yugoslavia	mines exploded on beach	43 killed, 57 injured	

Date	Location	Type and quantity	Extent or radius of damage & casualties	Cause(s)
23 October 1946	Manado, North Celebes, Indonesia	Japanese sea mines exploded	34 killed	
20 February 1947	O'Connor Electroplating Company, Los Angeles, California	chemical plant	four city blocks destroyed; 15 killed, 158 injured	error in mixing chemicals
16 April 1947	SS <i>Grandcamp</i> , Texas City, Texas	explosive chemicals; 2,300 tons ammonium nitrate	3 km; 552 killed, 3,000 injured, 200 missing	initiated by paper sacks igniting in the hold
17 April 1947	SS <i>High Flyer</i> , Texas City, Texas	explosive chemicals; 2,000 tons ammonium nitrate	included in above figures	fire on the <i>Grandcamp</i>
28 July 1947	SS <i>Ocean Liberty</i> , Brest, France	explosive chemicals; 3,300 tons ammonium nitrate	5 km, 650 million francs damage; 21 killed, 100 injured	fire
18 August 1947	La Carraca arsenal, Cádiz, Spain	munitions	a "tremendous and catastrophic" explosion ripped through shipyards, factories, and houses, killing 149 and wounding hundreds more	
28 July 1948	I.G. Farben, Ludwigshafen, West Germany	chemical works; 30 tons of liquefied dimethyl ether	\$15 million damage; 207 killed, 3,818 injured	structural failure of tank car
26 July 1949	Tarancon, Spain	ammunition dump	25 killed	
6 April 1953	Nantsechu [Hsinchu?], Taiwan	ammunition dump	54 killed, 250 injured	
18 August 1953	Benghazi, Libya	ammunition explosion	50 killed	
12 September 1953	Wuensdorf, Germany	ammunition explosion	20 killed	
17 May 1956	Takoradi, Ghana (Gold Coast)	ammunition dump	25 killed	
7 August 1956	Cali, Colombia	dynamite	1,200 killed; 2,000 buildings destroyed	seven army trucks, parked overnight in a working class district in the centre of the city, exploded; cause unknown
1 July 1957	Naha, Okinawa, Ryuku Islands, Japan	sunken munitions ship	32 killed	
19 February 1958	SS <i>Seistan</i> , Bahrain	commercial explosives	57 killed	spontaneous combustion
17 April 1958	WWII merchant vessel <i>Canada Victory</i> , off Okinawa, Ryuku Islands, Japan	munitions ship	40 killed	salvage worker attempted to breach hull with homemade explosive charge
4 March 1960	French ship <i>La Coubre</i> , Havana, Cuba	munitions ship	100 killed, 200 injured	
23 July 1964	Egyptian ship <i>Star of Alexandria</i> , Bône, Algeria	munitions ship	\$20 million damage; 100 killed, 160 injured	unknown; accident occurred while vessel was being unloaded

23 July 1966	SS <i>Kielce</i> , Strait of Dover, England	munitions ship; about 2,000 tons	minor damage at Folkestone, 5 km away	accidental detonation during salvage operations
13 April 1976	Lapua Cartridge Factory, Lapua, Finland	munitions plant; 4,000 lbs. of powder	43 killed, more than 70 injured	powder in feeder unit ignited

*This list attempts to gather together data on major explosions with certain similarities to the 1917 disaster in Halifax Harbour, such as munitions accidents; accidents with multiple civilian casualties; comparable areas of devastation; explosions in urban locations; or extensive damage to property. All are believed to be accidental, with the exceptions of Black Tom Island (1916), which was an act of sabotage (although this was not proven until much later), and Fort Smederovo, Yugoslavia (June 1941). The explosion on the SS *Malakand* (1941) was indirectly caused by German bombing. Sources: *New York Times Index* 1914-1919, 1921, 1924-26, 1931, 1935, 1947, 1958; *New York Times*, 13 March 1907, 1, 3; 15 March 1907, 4; 29 August 1907, 3; 17 October 1907, 11; 27 September 1911, 4; 27 November 1914, 1, 2; 13 April 1915, 1; 7 February 1916, 1; 16 May 1916, 9; 31 July 1916, 4; 16 August 1916, 3; 21 August 1916, 1; 12 September 1916, 1; 18 November 1916, 3; 22 November 1916, 1; 24 November 1916, 1; 17 December 1916, 8; 7 December 1917, 2; 10 August 1921, 4; 22 September 1921, 2; 2 March 1925, 2; 26 May 1925, 21; 1 May 1931, 23; 3 May 1931, 12; 6 May 1931, 12; 14 June 1935, 1, 3; 15 June 1935, 6; 10 June 1941, 12; 21 April 1944, 3; 22 April 1944, 5; 6 July 1944, 1; 2 November 1944, 1; 3 November 1944, 7; 13 April 1945, 11; 19 August 1947, 1, 3; 31 August 1947, 17; 17 November 1947, 1; 19 November 1947, 2; 18 April 1958, 2; 19 April 1958, 9; unidentified newspaper clipping listed in *Lloyd's War Losses*, Vol. 1 (London, 1989), 806. *London Times*, 29 July 1947, 4; 30 July 1947, 3; 31 July 1947, 3, 8; Leonard A. Spencer, "The Conveyance of Dangerous Substances in Ports" (Health and Safety Executive, 1980); Jay Robert Nash, *Darkest Hours: A narrative encyclopedia of worldwide disasters from ancient times to the present* (New York: Pocket Books, 1977), 304, 654-62; Ralph Assheton, *History of Explosions on which American Table of Distances is based, including other explosions of large quantities of explosives* (Institute of Makers of Explosives, 1930); C.S. Robinson, *Explosions, Their Anatomy and Destructiveness* (New York: McGraw-Hill, 1944), Appendix, 80-85; V.C. Marshall, *Major Chemical Hazards* (Chichester: Ellis Horwood, 1987), 224-26; V.C. Marshall, "A Perspective View of Industrial Disasters," *ATOM* 375 (February 1988); 3; H.J., "Audibility of the Oppau Explosion in England," *The Meteorological Magazine*, vol. 56 no. 670 (November 1921): 279; James Cornell, *The Great International Disaster Book* (New York: Charles Scribner's Sons, 1976), 231-38; Louis A. Medard, *Accidental Explosions*, Vol. 2 (Chichester: Ellis Horwood Ltd., 1989), 739; Arthur Pine Van Gelder and Hugo Schlatter, *History of the Explosives Industry in America* (New York: Columbia University Press, 1927), 584; Maj. Gen. Julian S. Hatcher (U.S. Army, Ret.), *Hatcher's Notebook* (Harrisburg, Pa.: The Stackpole Company, n.d.), 520-24; G.S. Biasutti, *History of Accidents in the Explosives Industry* (published privately, Vevey, Switzerland, 1985); Tony Aldous, "The Bumps in the Night," *History Today* 36 (December 1986), 4-5; William Barr, "The Role of Expatriate Canadian and Newfoundland Ships in the Development of the Soviet Northern Sea Route and the Siberian Route, 1920-1960," in *SIBÉRIE I. Questions Sibériennes: Économie, Écologie, Stratégie*. (Paris: IMSECO, 1984), 378; Y.Y. Frumenkov, "Explosion in the Port," in *Arkhangel'sk: 1584-1984* (Arkhangel'sk: Sev.-Zapublishing House, 1984), 119-22; P.A. Warneck, "Russkii Sever v pervuiu mirovuiu voinu [The Russian North during the First World War]," *Morskii zapiski* (Naval records), VIII, No. 1 (March 1950): 32-42, and no. 2 (June 1950): 27-28; Fax transmissions, Herr Dr. Manfred Rauchensteiner and Dr. Karl Glaubauf, Heeresgeschichtliches [Army] Museum, Vienna, 10 March 1993 and 5 April 1993, respectively.

15. MacMechan, "The Halifax Disaster."
16. Fraser Harris, "Medical Relief Work."
17. MacMechan, "The Halifax Disaster."
18. Ibid.
19. Ibid.
20. Ibid.
21. Ibid.
22. Tooke, "An Experience through the Halifax Disaster," 308.
23. Dr. Thomas A. Foster, "The Halifax Disaster," *Journal of the Maine Medical Association* VIII, no. 7 (February 1918): 202.

White: Exploding Myths

1. The author is grateful to Alan Ruffman, David Cotgrove, V.C. Marshall, and David Simpson for generously sharing material from their own files on major explosion accidents and for providing helpful comments on an earlier draft of the original paper. Alan Ruffman's ongoing interest and unflagging dedication to this topic have been especially inspiring. Acknowledgments are also owing to William Barr, Rick Brown, Dick Shaw, Marjorie G. McNinch, Lynn-Marie Richard, Christine Holden, Bruce Lincoln, John Long, Lilia Ripinskaya, and Tania Zharova. Anne Ward deserves special credit for her exemplary assistance. I would also like to thank all the people who responded to my queries on the Internet, including Bayla Singer, Lenny Abbey, Barbara Nowak-Teufl, Charles Schneider, Philip Schwarz, Barbara Clemenson, Gail Pietrzyk, Norman Pereira, Barbara Norton, Peter Vorobieff, John Daly, and Bill McCutcheon.
2. The phrase gained popular acceptance after the publication of Michael J. Bird's *The Town That Died* (Toronto: Ryerson, 1962); see also Graham Metson, ed., *The Halifax Explosion* (Toronto: McGraw-Hill Ryerson, 1978).
3. The Appendix at the end of this chapter is a chronological listing, not a ranking, of selected major explosion accidents. Others have compiled similar lists in the past; three of the most useful are those of Robinson (1944), Nash (1976), and Biasutti (1984). Robinson documents nearly 140 major explosions up to the year 1943. Nash also lists well over a hundred explosion accidents, many of which are not covered by Robinson, though fewer details are given and inaccuracies abound. Biasutti is the most ambitious, annotating 515 explosions between 1652 and 1984, but he admits that his list is "full of gaps" and the data is "far from complete." Regrettably, the same disclaimer applies to my Appendix. C.S. Robinson, *Explosions: Their Anatomy and Destructiveness* (New York: McGraw-Hill, 1944), 80-85; J.R. Nash, *Darkest Hours: A narrative encyclopedia of worldwide disasters from ancient times to the present* (New York: Pocket Books, 1977), 654-62; G.S. Biasutti, *History of Accidents in the Explosives Industry* (published by the author, Vevey, Switzerland, 1986).
4. On the Oppau explosion, see the *New York Times*, September 22-23, 1921; October 31, 1921, 14; November 4, 1921, 16.
5. Julian S. Hatcher, *Hatcher's Notebook* (Harrisburg, Pa.: Stackpole, n.d.), 520-24. A bolt of lightning touched off a fire in a "temporary" magazine, which led just five minutes later to the detonation of 500 tons of TNT. During the next ten hours, other magazines in the depot also caught fire and exploded. Property damage was heavy, but casualties were light because it was a Saturday. Document excerpt courtesy of Lenny Abbey.

6. See Appendix.
7. The Halifax Harbour explosion is a good example of this—only recently has the quantity of explosives on board the *Mont Blanc* on December 6, 1917, been accurately determined. Alan Ruffman, "Amount of Explosive Material on Board the MONT BLANC taken from the original 'Shipper's Export Declarations' and from the original 'Manifest de frêt,'" unpublished, October 1992. The inquiry and subsequent court cases in the wake of the disaster sought to prove human culpability rather than to determine the physical causes of the explosion and the extent of devastation in loss of life and property damage. As a result, basic questions such as whether or not the explosion made a crater, or how many people died in the initial blast as opposed to perishing later in fires, are still open to debate.
8. An explosion of 85 tons of black powder (a.k.a. gunpowder) in Brescia, Italy, in 1769 killed more than 3,000 people and destroyed nearly 200 buildings. Biasutti, *History of Accidents*, 15; Nash, *Darkest Hours*, 654. Another source reports that a magazine located in the basement of a church on the island of Rhodes, Greece, exploded in 1856, killing an estimated 4,000 inhabitants. James Cornell, *Great International Disaster Book* (New York: Charles Scribner's Sons, 1976), 229.
9. *Blaster's Handbook: A Manual Describing Explosives and Practical Methods of Use*, fifteenth edition (Wilmington, Del.: E.I. du Pont de Nemours, 1969), 25; see also Hatcher, *Hatcher's Notebook*, 519.
10. Biasutti, *History of Accidents*, 45.
11. Ibid., p. 11. The *Mont Blanc* carried 62 tons of guncotton as part of its cargo on December 6, 1917. Ruffman, "Explosive Material," 34.
12. A product of this concern was "The American Table of Distances," first issued in 1909 by the Institute of Makers of Explosives at the request of the U.S. government, which assembled data on major explosion accidents to establish guidelines for the design and location of munitions plants and storage facilities. Biasutti, *History of Accidents*, 8. See also Ralph Assheton, *History of explosions: on which the American table of distances was based, including other explosions of large quantities of explosives* (Wilmington, Del.: Charles L. Story, 1930).
13. Biasutti, *History of Accidents*, 13. The advent of high explosives would eventually supplant black powder in commercial applications, but during the war, demand for the latter actually increased. In fact, the highest level of production ever achieved for black powder in the United States was 277 million pounds in 1917. The record year for manufacture of high explosives was 1957, with nearly 1.2 billion pounds produced. This was nearly three times the annual production totals reached in the U.S. during the Second World War. *Blaster's Handbook*, 22, 503.
14. *New York Times*, July 31, 1916, 4.
15. *New York Times*, January 13, 1916, 5.
16. Jasena R. Foley, *The Night the Rock Blew Up* (Onondaga, N.Y., 1988), 1, 4, 24.
17. Biasutti, *History of Accidents*, 55-56.
18. *London Times Index*, 1917.
19. Although it was reported in the American press that as many as 300 were killed, the official record states that 73 people died as a direct result of the explosion and some 400 were injured, according to information taken from British newspapers and forwarded by Dr. V.C. Marshall (fax transmission, February 27, 1993). Two books on this disaster are Michael Paris, *Silvertown 1917* (Hornchurch: Henry, 1986), and Gerard Melia, *The Silvertown disaster* (Harlow: Longman, 1984).
20. Biasutti, *History of Accidents*, 54.
21. *New York Times*, June 24, 1917, 2; August 7, 1917, 2.

22. In April 1918 the *New York Times* claimed that the Austrians lost two black powder factories near Salzburg on the same day. Efforts to substantiate this report have failed, however, leading the author to conclude that it was a product of the overly patriotic journalism characteristic of the day. *New York Times*, April 25, 1918, 10.
23. During the First World War, the Austrian army maintained a weapons testing range there. See Anthony Allfrey, *Man of Arms: The Life and Legend of Sir Basil Zaharoff* (London: Weidenfeld & Nicolson, 1989), 47. The major town in the Steinfeld region, Wiener Neustadt, is well known for its military installations. Anton Ertl to the author via Internet, January 19, 1993.
24. The Steinfeld explosion is mentioned in Melvin Cook, *Science of High Explosives* (New York: Reinhold, 1958), 7, citing Robinson, *Explosions*. The Robinson book contains no reference to Steinfeld. Leonard Spencer also lists Steinfeld in a table of "The Ten Largest Accidental Explosions" in his paper "The Conveyance of Dangerous Substances in Ports" ([British] Health and Safety Executive, 1980), 2.
25. The only explosion accident on record in the Steinfeld region during 1917 happened on June 17th when a cache of Italian munitions captured by the Germans blew up at the Blumau powderworks. Six persons were killed and more than 300 were injured. Material damage was heavy, but the quantity of explosives involved is not known. There are conflicting reports regarding the death toll in the Wöllersdorf accident; some reports claim as many as 423 workers died, including many women. Fax transmissions to the author from Dr. Manfred Rauchensteiner and Dr. Karl Glaubauf, Heeresgeschichtliches [Army] Museum, Vienna, March 10, 1993 and April 5, 1993. The translation assistance of Angelique De Benedetti is much appreciated.
26. *Times* (London), December 21, 1916, 8.
27. *Encyclopaedia Britannica*, twelfth edition, "Munitions of War."
28. Ibid.
29. L.K. Yates, *The Woman's Part: A Record of Munitions Work* (London: Hodder and Stoughton, 1918), 8.
30. Ibid., 12.
31. *New York Times*, December 7, 1916, 1.
32. Ibid.
33. C. Ernest Fayle, *Seaborne Trade: History of the Great War*, Vol. II (London: John Murray, 1923), 350. See also Fayle, *Seaborne Trade*, Vol. III (1924), 239; Henry Newbolt, *Naval Operations: History of the Great War*, Vol. V (London: Longmans, Green, 1931), 325.
34. Y.Y. Frumenkov, "Explosion in the Port," in *Arkhangel'sk: 1584-1984* (Arkhangel'sk: Sev.-Zap., 1984), 119-22, published in Russian. I am indebted to Lilia Ripinskaya of Arkhangel'sk for locating this reference and translating relevant passages.
35. P.A. Warneck, "Russkii Sever v pervuiu mirovuiu voinu [The Russian North during the First World War]," *Morskii zapiski* (Naval records) VIII, no. 1 (March 1950): 37-38. The author is most grateful to Tania Zharova for translating relevant portions of this article.
36. *New York Times*, November 22, 1916, 1. The *Times* reported 341 dead and 667 injured versus much higher figures given by Frumenkov. Property damage in Halifax and Dartmouth was estimated at \$35 million; Janet Kitz, *Shattered City* (Halifax: Nimbus, 1989), 179. It is not known whether this figure includes the US\$3.6 million value placed on the cargo of the *Mont Blanc*. Alan Ruffman, "Value of Explosive Cargo on Board the MONT BLANC, December 6, 1917, as taken from the original 'Shipper's Export Declarations,'" unpublished manuscript.
37. Warneck, "The Russian North," no. 1, 37. Lloyd's Register of Shipping (1916-17) lists

- the *Baron Driesen* as having a length and beam of 345.4 feet by 47.9 feet (105.3 metres by 14.6 metres). (My thanks to Lynn-Marie Richard for retrieving this information.) The corresponding measurements for the *Mont Blanc* were 330 feet by 40 feet (100 metres by 12 metres), according to Kitz, *Shattered City*, 3.
38. Frumenkov ("Explosion in the Port"), writing in 1984, claims it was an act of sabotage, which conflicts with conclusions drawn by Warneck ("The Russian North") in 1950.
 39. Originally named the *Iceland*, the *Semen Chelyuskin* was under construction in Scotland for a Newfoundland sealing company when it was sold to the Russians in 1915. See William Barr, "The Role of Canadian and Newfoundland Ships in the Development of the Soviet Arctic," *Aspects* 9, no. 1 (July 1977): 21. I am grateful to Rick Brown for bringing this article to my attention.
 40. *New York Times*, February 21, 1917, 1; Frumenkov translation.
 41. Barr, "Role of Canadian and Newfoundland Ships," 23. For the *Ekonomia* explosion, Barr cites N.A. Zaleskiy, "Flot russkogo severa v gody Pervoy Mirovoy i Grazhdanskoy voyn," *Letopis' Severa* 6 (1972): 132. Zaleskiy in turn cites the Central State Archives of the Russian Navy (TsGAVMS, s.418, op.2, d.640, l.42, 43, 106). The author is indebted to William Barr for his assistance in tracing and translating this reference.
 42. P.A. Warneck, "Russkii Sever v pervuiu mirovuiu voynu [The Russian North in the First World War]," *Morskii zapiski* (Naval records) VIII, no. 2 (1950): 27-28. I am much indebted to John Long for sharing this reference and providing a translation. (Alternate spellings result from different transliteration methods. Differences in dates cited by Warneck and other sources relate to the use of either Julian [Old Style] or Gregorian [New Style] calendars; for example, Zaleskiy gives the date of the accident as January 13, 1917.) All dates cited in the text are Gregorian. According to Lilia Ripinskaya, Frumenkov states the casualties at *Ekonomia* were 507 killed or wounded, but this figure was "underestimated."
 43. Great loss of life was reported in another vague report about Russia. An explosion sometime in late 1916 was alleged to have "completely destroyed" an ammunition factory "on La Satannaya." Quoting Russian and German sources, the *New York Times* claimed that "about 1,000 persons were working in the factory, all of whom . . . perished." *New York Times*, December 10, 1916, 1. Although Nash (*Darkest Hours*, 657) mentions this accident (and places the date of its occurrence at November 16th), no further information has been found on this incident.
 44. On munitions production in Canada, see H.H. Vaughan, "The Manufacture of Munitions in Canada," address to the Engineering Institute of Canada, February 10, 1919; and David Carnegie, *History of Munitions Supply in Canada, 1914-1918* (London: Longmans, Green, 1925). On production in the United States, see Benedict Crowell, *America's Munitions, 1917-1918* (Washington, D.C.: U.S. Government Printing Office, 1919); Benedict Crowell and Robert Forrest Wilson, *The Armies of Industry*, 2 vols. (New Haven: Yale University Press, 1921); and Arthur Pine Van Gelder and Hugo Schlatter, *History of the Explosives Industry in America* (New York: Columbia University Press, 1927). On production in Great Britain, see John Dick Scott, *Vickers: a history* (London: Weidenfeld and Nicolson, 1962); R.J.Q. Adams, *Arms and the Wizard: Lloyd George and the Ministry of Munitions, 1915-1916* (London: Cassell, 1978); *Great Britain: History of the Ministry of Munitions* (Brighton, Eng.: Harvester, 1976); and Anthony Allfrey, *Man of Arms* (London: Weidenfeld and Nicolson, 1988).
 45. *New York Times*, July 31, 1916, p. 4.
 46. Coincidentally, the munitions were part of a shipment bound for the Russian front via Arkhangel'sk. Walter Isaacson and Evan Thomas, *The Wise Men: Six Friends and the World They Made* (New York, 1986), 123.

47. *New York Times*, July 31, 1916, 4.
48. *Ibid.*, 1; *New York Times*, August 2, 2. Later that year, the rail carrier involved in the incident, the Lehigh Valley Railroad, sued the municipality in an effort to have the ordinance revoked. See *New York Times*, October 24, 1919, 4.
49. *New York Times*, August 1916, passim. The Black Tom Island case became one of the most litigious damage suits in U.S. history. In 1919 the Russian government sued the Lehigh Valley Railroad in a bid to recoup the value of munitions lost in the explosion. Despite legal arguments that the suit was invalid because the Kerensky regime was no longer in power, the American judge ruled in favour of the Russians in 1925. *New York Times*, January 23, 1919, 24; January 29, 1919, 24; June 26, 1925, 8. Meanwhile, the Lehigh Valley Railroad and other American claimants took their case to the Mixed Claims Commission in The Hague, seeking damages for losses sustained in the explosion, "for which German government agents are held responsible." *New York Times*, January 26, 1924, 26. A decision was finally handed down in 1939, when more than \$21 million in compensation was awarded to the American companies, including the manufacturers of the dynamite, Bethlehem Steel. The commission ruled that the Black Tom Island explosion had been caused by sabotage. See Isaacson and Thomas, *The Wise Men*, 123-25.
50. Tony Aldous, "The Bumps in the Night," *History Today* 36 (December 1986): 4.
51. Angus Calder, *The People's War* (New York: Ace, 1972), 374.
52. *Ibid.*, 376. A cursory survey of the *London Times Index* for the years 1940-45 reveals a large number of fatal industrial accidents, many of which occurred in munitions plants.
53. Spencer states that following the *Malakand* incident in May 1941 (see Appendix), steps were taken to limit the quantity of munitions carried in a single vessel to 250 tons. However, this rule was apparently not rigidly enforced. Spencer, "Convergence of Dangerous Substances in Ports," 3.
54. The day is a black one in the annals of marine history, for it also marks the anniversary of the *Titanic* disaster.
55. John Ennis, *The Bombay Explosion* (London: Cassell, 1959), 5.
56. W.H. Mitchell and L.A. Sawyer, *The Oceans, the Forts and the Parks* (Liverpool, 1966), 52.
57. Ennis, *Bombay Explosion*, 36.
58. *Ibid.*, 89.
59. *Ibid.*, 123-24.
60. *Ibid.*, 120.
61. Mitchell and Sawyer, *The Oceans*, 53.
62. Ennis, *Bombay Explosion*, 204.
63. *Ibid.*, 45-46.
64. *Ibid.*, 133.
65. *Ibid.*, 207.
66. It was not, however, the most well-known munitions explosion in U.S. history—that distinction belonged to the sinking of the *USS Maine* in Havana harbour in 1898. At the time, U.S. navy concluded rather hastily that the *Maine* had been blown up by a mine. More recent reevaluations of the episode suggest that an internal explosion, probably caused by spontaneous combustion of coal stores adjacent to the ship's magazine, was the real cause. See Theodore Rockwell, *The Rickover Effect* (Annapolis, Md.: Naval Institute, 1992), 344-46. My thanks to David Beatty for bringing this book to my attention.
67. *New York Times*, July 19, 1944, 1, 14.

68. Ibid., 14.
69. Ibid.
70. Robert L. Allen, *The Port Chicago Mutiny* (New York: Warner Books, 1989), 57.
71. Ibid., passim. See also Studs Terkel, *The Good War: An Oral History of World War II* (New York: Ballantyne, 1984), 392-401.
72. Peter Vogel, "The Last Wave from Port Chicago," *The Black Scholar* (Spring 1982): 38; *New York Times*, July 19, 1944, 14. Reference courtesy of David Simpson.
73. N.W. Robinson, "The Fauld Disaster, 27th November 1944," manuscript, n.d. Reference courtesy of V.C. Marshall.
74. Byron Rogers, "Britain's biggest bang," *The Weekend Guardian*, March 11-12, 1989, 3. I am indebted to Steve Hayhurst for this reference.
75. *Halifax Herald*, November 28, 1944, 1.
76. Trevor Jones, "The Great Fauld Explosion," *Staffordshire Studies* 1 (1988): 58. Reference courtesy of V.C. Marshall.
77. *Halifax Herald*, November 28, 1944, 1; *New Civil Engineer*, May 26, 1988, 20.
78. Jones, "Great Fault Explosion," 59.
79. As a result of mounting pressures by mid-1944 to keep the U.S. army air force regularly supplied with 4,000-pound HE bombs, nearly 200 Italian prisoners-of-war, termed "co-operators" after the Italian armistice in May, were employed at RAF Fauld. John Reed, "Fauld: November 27 1944," *BPB News*, no. 138 (April 1987): 18. Reference courtesy of V.C. Marshall.
80. Ibid., 20.
81. Ibid., 21.
82. "The largest explosion in the UK, Fauld, 1944," *Loss Prevention Bulletin* (published by the Institution of Chemical Engineers, Rugby), no. 103: 17. Reference courtesy of V.C. Marshall.
83. Jones, "Great Fault Explosion," 61, 66; A.P. Burnside, "RAF Fauld," *Royal Engineers Journal* (1988): 65. Reference courtesy the Royal Engineers Library, Brompton Barracks, Chatham, England, via Alan Ruffman.
84. In 1988 a feasibility study prepared by the Royal Engineers concluded that restoring the mine was "uneconomic" because the cost (£500,000 for fuel alone), the estimated time required (three years), and the probability of "a significant quantity of unexploded ordnance remaining within the collapsed gallery system." Burnside, "RAF Fauld," 69.
85. Ibid., 57, 73; Reed, "Fauld," 21.
86. David Cotgrove to Alan Ruffman, April 28, 1992; David F. Cotgrove, David A. Atkinson, and Richard Anthony Baker, "The Explosive Cargo of the USS Richard Montgomery: A Study into the developing hazard from a marine wreck in the Thames Estuary between Sheerness and Southend-on-Sea" (Southend-on-Sea & District Chamber of Trade & Industry, 1972). Document courtesy of David Cotgrove.
87. Cotgrove to Ruffman, November 5, 1992. In a recently published fictional treatment of the *Richard Montgomery* story, entitled *Escapade 297* (London: Regency Press, 1990), by Barrie Anderson, a cloak-and-dagger plot revolves around the premise that the vessel contains a nuclear device which had been intended to give the Allies a retaliatory capability had the Nazis employed something equally unpleasant. "Wreck and cargo were [thus] abandoned and left unsalvaged to ensure that these wartime secrets did stay secret." David Cotgrove to the author, January 22, 1993. It is interesting, if not surprising, that similar "super-bomb" theories were advanced in the Port Chicago and Hanbury explosions, both of which occurred around the time the *Richard Montgomery* met its fate.
88. Cotgrove et. al., "The Explosive Cargo of the USS Richard Montgomery," sec. 6.3.3.