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From Nagasaki to Toronto

Omond Solandt and the Defence Research Board's Early Vision of Atomic Warfare, 1945-1947

Jason S. Ridler

Although Canada did not embark on an atomic weapons programme, and indeed actively supported proposals for atomic disarmament, nonetheless the Canadian Services had to be trained and equipped to fight in atomic wars should the need ever arise. Helping in this task was the central role of the Defence Research Board.¹

O.M. Solandt, 1958

Omond McKillop Solandt's selection in 1945 as the founding director general of the Defence Research Board (DRB), Canada's first peacetime defence research organization, owed much to his experience in the investigation of the results of the nuclear attacks on Hiroshima and Nagasaki. From October to December 1945, Colonel Solandt,² a physiologist and pioneer in operational research, headed the British field team that examined the number and nature of casualties from the atomic bombs. Thus in 1945 he was the only Canadian officer with first hand expertise on the reality of atomic weapons.³

Upon becoming director-general of the DRB Solandt made it his top priority to share this expertise in a series of lectures for Canadian leaders in industry, medicine, and civil defence, as well as the military. These lectures, by Canada's leading defence scientist, provide a frank and detailed account at the dawn of the nuclear age of atomic weapons about the damage Canadian cities would suffer in a nuclear war. For Solandt atomic war was no theory but a reality that had to be confronted

ABSTRACT: In November 1945, Canadian physiologist Colonel Omond Solandt became one of a handful of experts on the effects of atomic warfare as a member of the British Mission to Japan (BMJ). The BMJ investigated the effects of the atomic bombs dropped at Hiroshima and Nagasaki, both on structures and people. Solandt's casualty analysis and experience in Japan became the prism by which his pragmatic intellect viewed atomic affairs during his tenure as Chairman of Canada's Defence Research Board (1946-1956), including the impact of atomic war on Canada.

in two ways. First, there had to be a concerted international effort for a stable peace. Second, given the likelihood that such an endeavour would fail, Canadian leaders had to understand nuclear warfare and be prepared for the worst. For Solandt, this realistic understanding was the critical component of "active defence" in the Cold War. One of the DRB's chief responsibilities for national defence, in his view, was to impart that understanding.

Career Highlights 1930-1945

Solandt came to military affairs by circumstance rather than inclination. Born in Winnipeg in

1909 to a clergyman and a university-educated mother, young Solandt held a wide array of interests which eventually led him to study science at the University of Toronto in 1927. He received gold medal standing for his bachelor thesis in biological and medical science in 1931 before beginning his master's in physiology under the guidance of Dr. Charles Best, the co-discoverer, alongside Sir Frederick Banting, of insulin.⁴ Best would introduce Solandt to his Cambridge mentors, including Sir Alan Drury. Under Drury's guidance, Solandt received his doctorate of medicine (MD) in 1936, and passed the dreaded exams set for membership in the Royal College of Physicians in 1939; a stellar rise for a young Canadian.⁵

Solandt was set to teach courses on mammalian physiology but the start of the Second World War changed that. Over the next six years, he distinguished himself in senior medical and defence research posts. He was the director of the Southwest London Blood depot (1940) during the early German bombing campaign against London. He was then assigned by the Medical Research Council to



**The atomic explosion at
Nagasaki, 9 August 1945.**

Colonel Omond Solandt photographed shortly after his arrival in Hiroshima, Japan.

create and direct the Physiological Laboratory at the Armoured Fighting Vehicles School at Lulworth Cove in Dorset. At Lulworth, Solandt and his team solved a crew problem by improving ventilation in armoured vehicles, and he soon became a pioneer in operational research.⁶ This success resulted in his assignment in 1942 to the British Army Operational Research Group (AORG).⁷ The following year Solandt became deputy to the AORG's superintendent, the South African radar pioneer Basil Schonland, whom Solandt greatly admired.⁸ By February 1944, Solandt joined the Canadian army with the rank of lieutenant-colonel. When Schonland was selected to become science advisor (SA) to Field Marshal B.L. Montgomery for the Normandy campaign in 1944, Solandt became superintendent of the BAORG with the rank of colonel.⁹ After the German surrender in May 1945, he received the appointment as science advisor to Lord Louis Mountbatten, commander-in-chief of South-East Asian Command and was prepared to depart for Burma when the atomic bombs were dropped on Hiroshima and Nagasaki in August 1945. The selection of a Canadian physiologist to get first hand data on atomic warfare largely rested on his medical training, his wartime record of excellence in managing a host of technological endeavours, and a pragmatism that matched his strong and meticulous intellect. All would be needed in the mission to Japan.



University of Toronto Archives (U of T Archives), B1991-0015/024(10)

The US Strategic Bombing Survey

On 3 November 1944 President Franklin D. Roosevelt approved Secretary of War Henry Stimson's request for the creation of a survey mission to conduct a "scientific investigation of all the evidence" of strategic bombing in the European Theatre that would provide the data needed for assessing post war strategic planning. The United States Strategic Bombing Survey (USSBS) came under leadership of Colonel Franklin D'Olier, President of Prudential Life Insurance Company.¹⁰

After the atomic bombing of Hiroshima and Nagasaki, President Harry S Truman authorized a mission for the Pacific. On 15 August 1945 Truman suggested to D'Olier that:

[I]t would be similarly valuable for our post-war planning and future

policies to have the same kind of impartial and expert study of the effects of our aerial efforts in the war against Japan. This study would include the effects of all types of air attack.¹¹

D'Olier, with Paul Nitze as his vice chair, began to assemble a team for Japan. In the fall of 1945, the US Chiefs of Staff invited the British to send their own mission to Japan. The British had participated in the European survey¹² and gladly accepted the offer. The British had contributed significantly to the US led effort to create the atomic bomb and were especially keen to assess the scope of atomic damage to an island nation for their own post war strategic planning.¹³

The British Chiefs of Staff quickly assembled the team, known as the British Mission to Japan (BMJ). It would be led by Professor W.N. Thomas, a civil engineer from Cardiff University in Wales, who had led many bomb damage assessment teams for the British Ministry of Home Security during the Blitz.¹⁴

In the fall of 1945, Solandt had become the Army Council's scientific advisor in the War Office. He was selected to represent the British army and instructed to investigate structural damage to military institutions. As Solandt later recalled, however, "there were no military installations in either Hiroshima or Nagasaki so I spent most of my time studying casualties from a medical point of view."¹⁵ Throughout his wartime experience Solandt had concerned himself with the nature of casualties. Solandt worked on blood research for bombing victims during the Blitz, corresponded with Home Security scientist Professor Solly Zuckerman on the nature of bombing casualties, and worked on

many tank casualty reports himself at Lulworth.¹⁶ He would head one of the two field units.

During the mission, Solandt received a directive from the US Chiefs of Staff on the nature of relations between the two bodies. It emphasized the collaborative nature of the enterprise, and included the following points:

3. The activities of the British party will, therefore, be governed by the terms of reference of the United States Strategic Bombing Survey. You should in consultation with Professor Thomas, head of the Civil Defence party, arrange with M. Franklin D'Olier, the Chairman of the U.S.S.B.S., how to make the best use of your particular qualifications, bearing in mind...the special importance of studying the results of the two atom bomb incidents at Hiroshima and Nagasaki.

4. You should not make any inquiries into research, constructional or operational aspects of atomic bombing that are outside the scope of the U.S.S.B.S terms of reference.¹⁷

The mission left Britain on 11 October and, after a week's stay in Washington, arrived in Tokyo on 27 October, where it was briefed on the effects of the atomic bomb by Japanese physicists and doctors who had been working with the American survey teams.¹⁸ The mission then spent an entire day flying in a C-47, examining other bomb sites in Japan to assess the differences with the atomic devastation of Hiroshima and Nagasaki. Solandt confessed that from the air only an expert could tell the difference between conventional and atomic bomb damage. The real work would have to be from the ground.¹⁹ Still, what they did see was "almost overwhelming. Each one

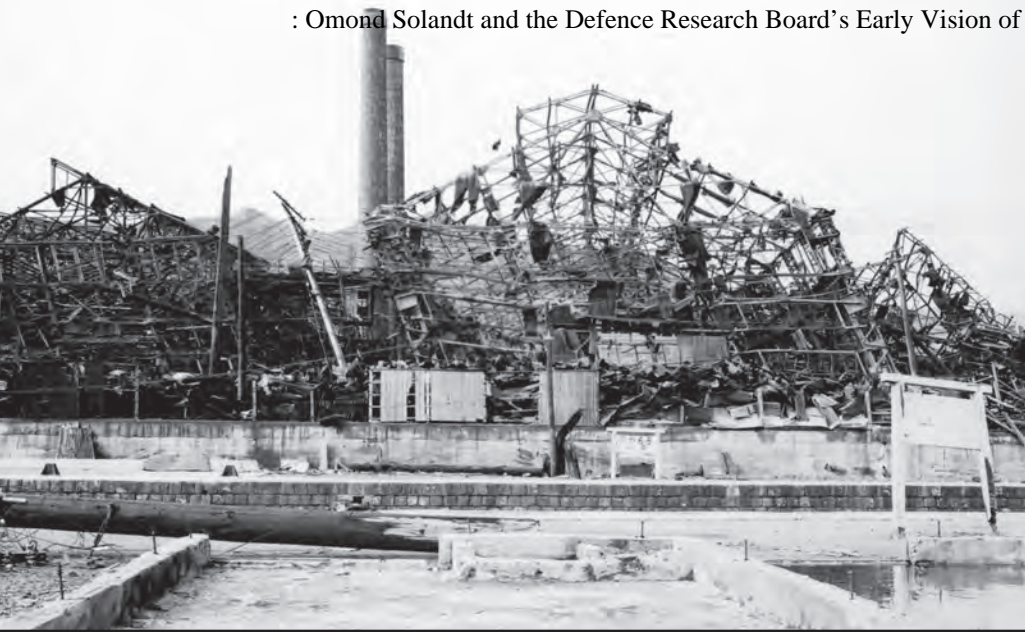
of these cities had been extensively devastated."²⁰

On 31 October, the mission, now situated at the British Consulate, began its work in Nagasaki. The USSBS provided lodgings and jeep transportation but largely left the British mission to its own devices. It was then that Solandt, because there were no military institutions of significance in Nagasaki, turned the team's attention to casualty analysis.²¹ He was joined in this effort by Jacob Bronowski, a renowned statistician adept at the mathematics of casualty surveys. Together, they investigated the number and nature of casualties from the atomic bomb in Nagasaki (2-13 November) then Hiroshima (14-24 November), Bronowski concentrating on the former and Solandt on the latter.²²

Walking through the world's first atomic battlefield was a life changing experience for both Solandt and

Nagasaki – A general view of the area near the centre of the damage, which is to the left of the picture, only 300 yards away from the bridge. Note how little remains of the blasted and burnt Japanese dwellings.





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Bronowski, and the two became good friends. Bronowski later recorded his impressions:

On a fine November day in 1945, late in the afternoon, I was landed on an airstrip in Southern Japan. From there a jeep was to take me over the mountains to join a ship which lay in Nagasaki Harbour...suddenly I was aware that we were already at the centre of damage in Nagasaki. The shadows behind me were the skeletons of the Mitsubishi factory buildings, pushed backwards and sideways as if by a giant hand. What I had thought to be broken rocks was a concrete power house with its roof punched in. I could now make out the outline of two crumpled gasometers; there was a cold furnace festooned with service pipes; otherwise nothing but cockeyed telegraph poles and loops of wire in a bare waste of ashes. I had blundered into this desolate landscape as instantly as one might wake among the craters of the moon.²³

Solandt was likely driving the jeep. Looking back at his friendship with Bronowski during that period, he reflected

Nagasaki:

Top: Mass distortion of steel-framed shed buildings about half a mile from the centre of damage. It can be seen that the entire main frame is seriously distorted away from the explosion.

Middle: This photo was taken 130 feet from ground level zero.

Bottom: The Roman Catholic Church 600 yards from the centre of damage. The walls were of heavy load-bearing brick construction. Most of the damage is attributable to blast, although fire subsequently consumed all combustible debris. The huts in the foreground were erected as temporary living quarters by the Japanese after the attack.

I realize that I was probably the more practical of the two, since when we were out together I drove while he planned. Incidentally, driving a large ¾ ton Dodge 4 x 4 in a ruined Japanese city requires as much concentration as writing poetry.²⁴

Solandt, in a letter to his family not long after the work began, reported that:

The damage is quite up to advance notices. The bomb lit in the northern part of the town where most of the factories are and completely devastated an area about one mile wide and 2 ½ miles long...I've been spending the last few days looking at the casualties that remain. They are a sorry looking lot since most of them have had practically no treatment. Fortunately most of the bad cases are dead and the others are getting better...The attitude of the Japs is quite amazing. They treat the Americans as welcome guests not as conquerors. The Americans in turn are very friendly especially to the kids. The kids are very attractive and spend most of their time talking to the troops. Kids about Sigrid's [Solandt's eldest daughter] age are to be seen carrying small brother or sister [sic] about on their backs all day – no wonder they grow up small and tough...I spent many several hours [in the previous days] looking at damage in the residential quarters – I have never seen such filth in all my life. It is a mystery how anyone survives. Every place is just full of dirty little kids with running noses and impetigo and probably fleas. I had a bath immediately upon returning.²⁵

Nagasaki – Blast effect on a gasholder half a mile away from the centre of damage. Not the way in which the whole framework has been bent away from the explosion.

The goal of the mission was to discover the number and nature of deaths in relation to the distance from the explosion and what structures were in the path of the shockwave and radiation.²⁶ Japanese hospital records on casualties were scattered throughout the region but they were of almost no value.

The rescue services were so slow in coming into action after the bombing and were so inadequate that no records were kept of the dead, injured, missing and evacuated people. The hospitals were so swamped with work that their records are of little value. The Japanese did make scattered attempts to keep records beginning a few days after the bombing but these were very incomplete.²⁷

When he first arrived Solandt also received information from a US/Japanese Joint Commission for the Investigation of the Effects on the Atomic Bomb that worked under the direct authority of General Douglas MacArthur, Supreme Allied Commander in the Pacific.²⁸ Solandt's interpreter was a further source, supplying first hand accounts of what had happened.

Solandt classified casualties into four general categories:

1. Ordinary thermal burns due to direct radiation from the heated air around the explosives.
2. By irradiation with gamma rays and other short-wave radiations.
3. By blast.
4. Secondary injuries due to being hurled against buildings or hit by buildings. Burns due to fires should be included in this group.²⁹

Solandt learned from the American/Japanese team that out of a population of 250,000 there were 21,000 killed, 1,000 missing, and 40,000 injured. All those out in the open and within 1000 metres of the centre died, though the cause of death was difficult to determine.³⁰

Those who were 1000-2000 metres away received heavy doses of radiant heat and gamma rays. Thick clothing could screen against the former, but the latter could penetrate up to 15 inches of concrete. Blast created minimal casualties at this range (10 percent). Screening determined the nature of the casualties at this range. The lightly clothed, which was most people in the summer heat, suffered severe flash burns and died before the radiation could kill them. Those who were more than 2000 meters away generally survived the flashburns

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Hiroshima – A general view looking across the centre of damage. Some framed buildings quite near the centre remained standing. The foreground illustrates the remains of Japanese dwellings, razed to the ground.

The entire mission was a rushed affair. The British were eager to get as much first hand data as possible to make their own independent analysis so that they would not have to rely entirely on US data. In preparing his reports, Solandt was adamant that the British Chiefs of Staff understand that the initial reports were preliminary at best and would be superseded by the final report.³³ Solandt and Bronowski worked on at least three drafts before completing the report "Casualties Due to the Atomic Bomb at Hiroshima and Nagasaki" in late November. This paper was included in the final report of the Mission, *The Effects of the Atomic Bombs at Hiroshima and Nagasaki* (1946).³⁴

The most important point made by Bronowski and Solandt was that at both cities civil defence measures, physical shelters and a proper organization had been virtually non-existent. Had such measures been in place, the damage and casualties, although devastating, would have been less severe. Such views are not surprising for men who worked so extensively in British civil defence.

Solandt and the Defence Research Board's view of Atomic Bombs

Solandt returned to Canada via the continental US on 15 December and arrived in Ottawa three days later. He completed his journey to England on 23 December. During the stopover in Ottawa Lieutenant-General Charles Foulkes, chief of the general staff since August, offered

but showed symptoms of irradiation, including epilation (hair removed from the roots).

While investigating some cases of structural damage, Solandt came upon two Franciscans from Quebec, Father Prudent Moffette and Brother Moreau. They had been in Japan for 17 years and were interned when the war broke out. Nagasaki, they claimed, had over 16,000 Roman Catholics and 8-10,000 were killed.³¹ Solandt also interviewed an eyewitness of the blast from the *Tsuruoka Maru*, a 10,000 ton vessel that was 4,000 yards away.

Three of them were on the bridge at the time – watched the parachute come down and one went to get glasses to observe them more clearly. All were looking toward [the] bomb when it went off. They saw a bright white light – heard one loud bang

followed by four smaller ones which they think were not echoes. The ship rocked violently but was not in any danger of capsizing. They did not emphasize any feeling of wind. Several others on the ship had mild flash burns on exposed skin. A few had blisters on their forearms. Next the whole area was covered with a white smoke which rose forming a bright fiery column which ended in a mushroom shaped head of white smoke. The bright white smoke rose and was followed by bluish smoke and then flames. The flames appeared within 1-2 minutes of the first flash. One man on the ship had his hat [black] charred by the flash—they disagreed about flame on the hat. Trees on the east of the harbour were seen to burst into flames within a minute or two. They also [saw] several small vessels between them and the bomb burning.³²

Solandt the job of director general of the new Defence Research Board.³⁵

Foulkes was convinced that Canada's post war defence required scientific research capabilities that specifically served the military. One of the key elements in Allied victory over the Axis during the Second World War had been a massive and concerted scientific effort that had been effectively applied to technology and operations. Canada had contributed significantly in many areas including radar and communications, explosives, and the research that had helped to develop the atomic bomb. The defection of Igor Gouzenko, a cipher clerk in the Soviet embassy in Ottawa, in

September 1945 had shaken the status quo. This revelation of a concerted Soviet espionage campaign against Canada, Britain and the United States dimmed hopes for a stable, lasting peace built on cooperation among the wartime Allied powers and signaled the beginnings of the cold war.

Emerging technologies such as jet aircraft and rockets destroyed the illusion that Canada remained a "fire proof house" safe in its geographical isolation. The Canadian military required scientific research capabilities.³⁶ During the war, Canadian defence research had grown under the National Research Council (NRC) and its wartime President C.J. Mackenzie.³⁷ After

the war the NRC quickly divested itself of most defence projects, and Mackenzie supported Foulkes's argument for a separate defence research establishment.³⁸

Solandt was appointed director general defence research on 28 December 1945. The Defence Research Board was subsequently "born" on 28 March 1947 and integrated within the defence department under the National Defence Act. Its mandate was to serve the military, act as the chief repository of research knowledge for the minister of National Defence, and run its own research establishments. The director general of the DRB had an equivalent rank of lieutenant-general, the same level as the chiefs

Hiroshima city hall, near ground level zero.





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Polished concrete has been roughened by flash heat effect at a distance of 200 yards from the centre of damage in Hiroshima. The polish remains only where shielded by (a) a man seated on the steps; (b) a man leaning against the corner of the plinth adjoining the steps; and (c) in the shadows of the plinth mouldings.

of the three armed services, and was a full member of the chiefs of staff committee who participated in Cabinet Defence Committee meetings.³⁹

Evidence about how Solandt was selected is largely anecdotal. His name was initially suggested to Foulkes by Solandt's mentor Charles Best, who had worked on wartime medical research projects for the Canadian military.⁴⁰ Upon Solandt's retirement from the DRB in 1956, Mackenzie shared with him his own recollections:

I don't know whether you ever knew the details but a group of us met in C.D.'s [Howe, minister of Munitions and Supply] office to decide whether or not to separate military and normal N.R.C. activities. The Cabinet Ministers agreed to such a decision and the next question arose as to who would head the organization. [Lieutenant-General] Charles Foulkes [chief of the general staff] and I were appointed a Committee to make recommendations. As we left C.D.'s office and went down

the corridor Charles said "The only Canadian that I know who has any connection with defence research and who would likely be available is a man called Omond Solandt." I immediately said "That is interesting because I have had him recommended to me by many people whose judgment I respect and I had intended to suggest the same name." We stopped immediately and said why don't we go back at once and make our recommendations, which we did. I doubt if any recommending Committee ever acted so soon after their appointment and I don't think any recommendation ever proved a better one.⁴¹

By 1946 Canadian policy towards nuclear weapons was already taking shape. Canada had participated in various scientific efforts that contributed to the making of the atomic bomb. This included membership in the Combined Policy Committee that had coordinated atomic research in the US, Canada and Britain. The end of the war forced Ottawa to review its participation

in nuclear development. King and L.B. Pearson, Undersecretary of State for External Affairs had gone to Washington in 1945 after the atomic bombs had been dropped and told the US Undersecretary of State Dean Acheson that Canada would not pursue an independent atomic weapons policy.⁴² The passing of the McMahon Act by the US Congress in 1946 effectively ended US participation with Ottawa and London on atomic projects, outside of buying uranium products from the Canadian government's crown corporation El Dorado.⁴³

This did not mean Canada ignored atomic affairs. Political efforts were made towards a *modus vivendi* with the US on atomic affairs after the MacMahon act, and relations on defence science matters with Great Britain remained strong. The creation of the research reactor at Chalk River, Ontario continued despite the removal of key British scientists in the post war period. The Canadian military also began embryonic doctrine on dealing with the casualties resulting from atomic weapons. Indeed, the Canadian government was all too cognizant of the new atomic world that had been awakened at Hiroshima and Nagasaki.⁴⁴ Solandt made it his goal as leader of the DRB to educate leading elements of Canadian society, both within and outside government, about the reality of atomic warfare

and what it meant to Canada in military and civil defence terms.

Among the many lectures Solandt gave in his first year at the DRB was a presentation in Toronto on 24 April 1947 to the Voluntary Health Committee of the House of Commons, a government committee concerned with medical affairs. The lecture took place against the backdrop of deepening international tensions. Soviet failure to remove troops from Iran in 1946 had created a war scare less than a year after victory in the Pacific. Germany remained divided and its fate undecided. Stalin and his ministers refused to consider anything but weak neighbour states on their

borders, and pursued aggressive diplomacy in the Mediterranean. On 12 March 1947, just weeks before Solandt's presentation in Toronto, President Truman, responding to a British request to take up Britain's role in Mediterranean affairs, had proclaimed the "Truman Doctrine" – the US would support those that opposed the influence of Moscow. A new war, in the atomic age, seemed very possible.⁴⁵

Solandt began his lecture by emphasizing that Canadians still found active warfare in North America difficult to comprehend, and that this complacency was dangerous:

In thinking about the bomb, it is therefore essential to realize that present developments in aircraft, and future development in rockets, will make it possible to attack this country from the air from almost any part of the world. The old days when we could feel secure behind oceans patrolled by friendly and powerful navies are gone. We must consider atomic bombs and other weapons of the future, not merely as weapons that might be used in the destruction of some enemy on distant shores, but as weapons that might at any time be used to destroy our homes and cities.⁴⁶

A British officer poses in a Japanese defensive position in Hiroshima.



Solandt then explored the lethality of atomic weapons, based on the reports of the British Mission, USSBS, and his own observations from his time in Japan. He told the crowd he intended to make a clinical analysis and suggested they read John Hershey's bestselling book *Hiroshima* for accurate personal accounts.

Solandt emphasized that atomic bombs caused casualties in significantly different ways than regular high explosives. They could, of course, injure by direct wounds from the fragments of the bomb, by

blowing bits of buildings against people, and people against buildings, or from direct blast, like HE bombs. What made the atomic bomb unique was its release of vast quantities of energy, both in the blast wave and as radiant energy. The radiant energy released extended through the entire spectrum and included light, heat and penetrating gamma rays. The radiant heat caused severe burns and gamma rays produced "delayed death by injury to the blood forming organs."⁴⁷ Solandt warned that estimates of the deaths in Hiroshima and Nagasaki

were tentative at best, but provided the following figures:

15-20% died as a result of gamma radiation.

20-30% died of flash burns.

50-60% were killed from falling buildings.⁴⁸

Solandt excluded from his analysis deaths resulting from collapsed structures. "We have become hardened to descriptions of this sort as a result of years of bombing in many lands. The injuries

Atomic bomb damage in Hiroshima.



by burns and gamma rays possess the added interest of novelty."⁴⁹

He further explained:

The heat liberated during the second or so during which the explosion lasted was so intense that people at distances up to two and half or three miles suffered burns not unlike a very severe sunburn. People directly under the bomb were actually charred black. The heat was of such short duration that buildings and even light clothing gave complete protection. The effect was as if a spotlight had been turned on the victims and they had been burned wherever the light fell on their exposed skin... Some people achieved a somewhat limited immortality when the heat permanently etched their shadow upon the roads and buildings.⁵⁰

Gamma rays, Solandt continued, penetrate through human tissue. This includes bone marrow, the spleen, and lymph nodes, places where blood cells are formed. The gamma rays killed the cells that normally divide to provide the body with new cells and death would occur within days or weeks, usually preceded by complete hair loss. Solandt also emphasized that many people recovered from gamma ray exposure. More tragically, all pregnant women within a mile of the bomb had miscarriages. No babies survived.⁵¹

Solandt attempted to simplify the complex effects of the bomb by focusing on one case study from his own experience. This was the group of 85 high school girls formed into a military unit in Hiroshima.

At the time of the explosion they were at various places in the ground of Hiroshima Castle, a little more than half a mile from where the bomb exploded. Of a group of fifty one who were in the open engaged in a ceremony of devotion to the emperor, all were so severely burned that they died within a few days. Eight of the remainder were in the wooden dormitory where the group slept. Of these, two were killed by the falling buildings and one was knocked into a moat and drowned. The remaining five were apparently uninjured as they had been protected from burns by the light building in which they were working. They all died in 12 to 19 days from the effect of the gamma

rays. The remaining twenty six girls, operating the Army telephone exchange, in a deep concrete shelter, were uninjured.⁵²

Solandt's occasionally dark sense of humour almost got the best of him in the original draft of this lecture. He deleted two "grim but interesting jokes" played by fate in the dropping of the atomic bomb. In one case a considerable percentage of Japanese prison inmates were sterilized by gamma rays from the bomb, "thus achieving a result that ardent advocates of eugenics have never been able to bring about." Then there was the case of a Japanese professor of radiology at Nagasaki medical



Omond Solandt.

school. The man had been slowly dying from leukemia; "proper x-ray treatment to prolong his life was not available in Japan." When the bomb went off, he was at such a distance that the dosage of gamma rays would have likely have prolonged his life. Unfortunately, he was standing in front of a lead screen at the time. He died of the leukemia a few weeks later.⁵³

Solandt proceeded with a slide show to explore and illustrate the effects of such weapons on a Canadian city. "In order to simplify the problem of visualizing the damage the hypothetical bomb has been exploded *directly over our auditorium*."⁵⁴ The zero point was the corner of College and Yonge in downtown Toronto. "There would be 30,000 houses damaged beyond repair," he concluded:

35,000 requiring extensive repair and 50-100,000 requiring first-aid repairs. This would result in about 400,000 people being rendered homeless. About half of these could return to their homes after temporary repairs. Of the remaining 200,000 about 50,000 would have been killed and an equal number would require prolonged hospital treatment. This leaves about 100,000 who would require to be rehoused [sic] either permanently or for the several months required to make major repairs. It is not possible to appreciate the significance of such figures at first glance. As you consider them, new and terrible implications appear. Just think, for instance, of the added suffering if such an incident occurred in sub-zero weather.⁵⁵

As the crowd considered these figures, a movie on Hiroshima was shown.

Solandt next examined the nature of the atomic bomb as a weapon. He made it clear that, as the Mission and USSBS reports had concluded, it had "tremendous but not unique destructive powers. The devastation wrought by ordinary HE bombs in Hamburg and by incendiaries in Tokyo was just as great as that in Hiroshima." Atomic bombs were expensive to make but cheap to use, reducing the cost of destroying cities to would be aggressors as well as accelerating the rate at which cities, like Toronto, could be destroyed. "This tremendous increase in the rate of destruction is probably the most important new factor that the atomic bomb as introduced to war."⁵⁶ There now existed a relatively inexpensive way for aggressors with global reach to destroy cities.

"We must," Solandt declared, "either be continually prepared for war or else eliminate the possibility of war." The latter was a very faint hope.

Until wars cease to occur we must be prepared to defend ourselves against all forms of attack including atomic bombs. I do not subscribe to the views that there is no defence against the atomic bomb. At least for the next few years atomic bombs will be carried in ordinary bombers which can be intercepted and destroyed just as in the past. When the long range rocket carrying an atomic warhead becomes a reality, there is little doubt that there be some means of defence against it. In addition to this active defence which is the responsibility of the Armed Forces, much can be done in the field of Civil Defence. Here the important measures will include psychological preparation of the people, so that attack will not weaken our will to resist; careful planning

of the location of new buildings and industries of national importance and the preparation of plans for rescue and repair services and for the treatment of casualties.⁵⁷

Solandt ended his lecture on a positive note. He championed the efforts by General A.G.L. McNaughton, Canada's representative on the United Nations Atomic Energy Commission, to regulate the creation and use of nuclear weapons, and called for the active pursuit of the elimination of war. As a doctor and a scientist, he had seen the terrific benefits from knowledge applied to relieve human suffering. War no doubt seemed the antithesis to such endeavours. Indeed, Solandt would spend the greater part of his life championing the use of science and technology to alleviate hunger and poverty in the third world. Solandt saw the United Nations (UN) as a possible problem solver of the dilemmas facing the world. But Solandt was also a realist. "Russian Imperialists" and their use of communist ideology threatened world stability and had to be faced, even in a world with atomic weapons. This mix of the scientists' belief in rational solutions and progress and a Cold Warrior's realism led Solandt to a hopeful pragmatism concerning Canada's fate in the atomic age.

War is still possible, and if we really believe in our cause we must be prepared to fight for it if necessary. We must even make preparations for the possibility of atomic bombs being dropped on Canadian cities, but such preparations must always be regarded as secondary in importance to our primary task of helping to evolve a world organization that will make war impossible.⁵⁸

Conclusion

In 1945 Omond Solandt became a chief contributor to Canada's early Cold War defence policy. As Chairman of the Defence Research Board, he maintained and oversaw the nation's first peacetime defence research establishment, served the defence research interests of the Canadian Armed Forces, and provided the minister of National Defence critical scientific and technological knowledge. He brought to these tasks a vast, sharp and diverse intellect that reflected his interests and experience, the most compelling at the time being his work in Nagasaki and Hiroshima in the wake of the world's first atomic attacks.

Because of his unique qualifications and life choices, Solandt arrived in Ottawa as Canada's chief expert on the effects of atomic weapons. His timing was impeccable. Solandt became director general of the DRB just as the relationship between Moscow and the west soured under Soviet intransigence and adventurism in the Middle East and the Mediterranean. As one of his first lectures of 1947 shows, Solandt feared the consequences of atomic weapons but he feared ignorance of their effect even more. Looking at the future from the start of the Cold War, Solandt mined his experience to paint a picture for his audience of hard realities and the need to face them despite the costs. Hope remained in the UN, but as they say in the Army hope is not a method. Knowledge of the realities of atomic weapons was the first step in coming to grips with their place in the world. Solandt, while not a fan of fiction, would no doubt have championed science

fiction author Isaac Asimov's famous quip as it pertained to Canada's view of atomic weapons:

If knowledge can create problems, it is not through ignorance that we can solve them.

For Solandt, knowledge of the reality of atomic warfare was the necessary first step towards sustainable peace or resolve in war.

Notes

- Omond M. Solandt, "The Nuclear Age," The Sixth Francis Sheperd Memorial Lecture, *Medical Service Journal, Canada*, 4 no. 10 (November 1958), p.681
 - Solandt served as a member of the Canadian Army in England during the war, achieving the rank of acting colonel. He was one of two members from the dominions to serve with the British mission in Japan, the other being a scientist from India. Solandt, with a bit of hindsight, believed this was evidence of India's immediate post war interests in atomic weapons.
 - Solandt, "The Nuclear Age," pp.681-682.
 - David Grenville, "Omond McKillop Solandt - A Biographical Sketch," in C.E. Law, G.R. Lindsey, and D.M. Grenville, eds., *Perspectives in Science and Technology: The Legacy of Omond Solandt, Proceedings of A Symposium held at the Donald Gordon Centre, Queen's University at Kingston, Ontario, 8-10 May 1994* (Kingston: Queen's Quarterly Press, 1994), pp.3-6. Charles Best's role in the discovery of insulin has been diminished in part by the thorough work of Michael Bliss on the life and times of Sir Frederick Banting. At the time, however, Best was still at the apex of the physiological world and drew students to study with him at the University of Toronto in great numbers, including Solandt's elder brother David, whom he would work with throughout the war in the area of blood transfusions. See Michael Bliss, *Banting: A Biography*, (Toronto: McClelland and Stewart, 1985) & Wilfred Eggleston, *Scientists at War* (London: Oxford University Press, 1950), p.247.
 - Ibid.
 - Ibid.
 - The origin of the term operational research is largely attributed to British radar pioneer Sir Robert Watson-Watt.
- When asked by a senior military officer what these "Boffins" were doing getting in the way of his men, Watt responded, on the fly, that they were conducting "operational research." Tom Shachtman, *Laboratory Warriors: How Allied Science and Technology Tipped the Balance in World War II* (Perennial: New York, 2003), pp.52-58. For Solandt's contribution to the development of OR, see Ronald W. Shephard, "The Influence of Solandt on the Development of Early Operational Research in Britain," in Law, et al, eds., *Perspectives in Science and Technology*, pp.30-46; Cecil E. Law, "Dr. Omond McKillop Solandt: Operational Research Pioneer," *INFOR* vol. XXXI, no. 2 (May 1993), pp.101-5.
- Brian Austin, *Schonland: Soldier-Scientist* (Bristol: Institute of Physics, 2001), pp.272, 273, 287, 289, 296, 300, 332, 334, 343, 390, 415, 422.
 - This distinction was two-sided. Solandt had wanted to lead one of the Army Operational Research Groups (AORGs) deployed to Normandy, but that job was given to British Lieutenant-Colonel Pat Johnson. These two thoroughly disliked each other. Austin, *Schonland*, pp. 288-290. See Terry Copp, "Operational Research in 21 Army Group" *Canadian Military History* 3 no. 1 (1994), pp.71-84.
 - The literature on the USSBS is vast, including the 200-plus reports of the survey. For an introduction to their content and organization, see *The United States Strategic Bombing Survey Summary Report (European War)* (30 September 1945) & David McIsaac, *Strategic Bombing in World War Two: The Story of the United States Strategic Bombing Survey* (New York and London: Garland Publishing, 1976). Other works of note on the USSBS are Paul Nitze, with Ann M. Smith and Steven L. Rearden, *From Hiroshima to Glasnost: At the Centre of Decision* (New York: Grove Weidenfeld, 1989), pp.25-45, Gian P. Gentile, "Shaping the Past Battlefield 'For the Future': The United States Strategic Bombing Survey's Evaluation of the American Air War Against Japan," *The Journal of Military History* 64 (October 2000), p.1085.
 - OM Solandt papers, University of Toronto Archives [UT OMS], B1991/0015/011 File 6. Copy of letter Truman to D'Olier (15 August 1945). Emphasis added.
 - McIsaac, *Strategic Bombing in World War Two*, pp.37, 64, 183.
 - Margaret Gowing, *Britain and Atomic Energy, 1939-1945* (London: MacMillan & Co. Ltd., 1965).
 - UT OMS B1991-0155/011 File 4. Solandt's incomplete manuscript, "The Atomic Bomb" (September 1980), pp.100-101.
 - UT OMS B1991-0155/011 File 4. Solandt, incomplete manuscript. "The Atomic Bomb" (September 1980), pp.100-101.
 - Cecil Law, *Omond McKillop Solandt: Operational Research Pioneer*, p.104. See

- Annex B "BAORG Reports Commissioned by Solandt." On Solandt's work on blood transfusion research, see National Archives (UK) FD 1/203, FD 1/5290. On operational research work on casualties, see AORG reports at National Archives (UK): WO 291/73, WO 291/596. His correspondences with Zuckerman can be found at the University of East Anglia (UK), Zuckerman Papers, SZ/CAS/113/1/63, SZ/OEMU/1/16/48, SZ/OEMU/1/16/49
17. OMS UT B1991-015/011, File 6. "Directive to Colonel Solandt." U.S. Assistant Chief of the Air Staff (Operations) Air Ministry, on Behalf of the Chiefs of Staff, n.d.
 18. UT OMS UT OMS B1991-0015/011, File 16. Solandt speech, "Jacob Bronowski in Japan - 1945." UT OMS B1991-0015/011, File 16. Solandt speech, "Jacob Bronowski in Japan - 1945," p. 4. It is possible that the scientists the mission spoke with were Dr. Yoshio Nishina, the leader of the "Rikken" group of Japanese scientists tasked with developing atomic power during the war. Ibid., File 6. "Intelligence Memorandum. 10 November 1945: Japanese Survey of Atomic Bombing of Hiroshima and Nagasaki."
 19. UT OMS UT OMS B1991-0155/011 File 4, "The Atomic Bomb" (September 1980), p.105.
 20. UT OMS B1991-0015/011, File 16. "Jacob Bronowski in Japan - 1945," p. 5.
 21. The British Mission to Japan consisted of two teams, one under Professor Thompson (RAF Field Team 1, Group 1) and the other under Solandt (RAF Field Team 1, Group 2).
 22. UT OMS B1191-0015/001 File 6. "Diary of Colonel O. M. Solandt on Chiefs of Staff Mission to Japan October to December 1945." n.p.
 23. Jacob Bronowski, *Science and Human Values* (London: Hutchinson of London, 1961), pp.13. Bronowski first presented these views on 26 February 1953 at the Massachusetts Institute of Technology
 24. UT OMS B1991-0155/011 File 16. "Jacob Bronowski in Japan - 1945," p.6.
 25. UT OMS B1991-0155/011 File 13. Solandt letter from Nagasaki, 6 November 1945.
 26. UT OMS B1991-0155/011 File 19 Unmarked draft "Casualties Due to the Atomic Bomb at Hiroshima and Nagasaki," (n.d.), pp.4-5 likely written at the end of November 1945.
 27. UT OMS B1991-0155/011. "Casualties Due to the Atomic Bomb at Hiroshima and Nagasaki." chapter draft, n. d.. Many versions of this chapter, which appears in the final report, maintain that one reason for the extensive damage done at both Hiroshima and Nagasaki was Japan's poor civil defence system.
 28. UT OMS B1991-0155/011 File 7 "Diary: Monday Nov 5 and Tuesday Nov 6 - Casualties," (1945), p. 7-8
 29. Ibid.
 30. UT OMS B1991-0155/011 File 7 "Diary: Monday Nov 5 and Tuesday Nov 6 - Casualties," (1945), p. 10.
 31. UT OMS B1991-0155/011 File 7 "Diary: Sunday Nov. 11," (1945), p. 24.
 32. Ibid.
 33. UT OMS B1991-0155/011 File 19. Handwritten note for typist of report.
 34. *The Effects of Atomic Bombs at Hiroshima and Nagasaki: Report of the British Mission to Japan* (London: Her Majesty's Stationary Office, 1946), pp.78-88.
 35. UT OMS B 1991/ 0015/011 File 6. UT OMS B1191-0015/001 File 6. "Diary of Colonel O.M. Solandt on Chiefs of Staff Mission to Japan October to December 1945." n.p.
 36. Sean Maloney, "General Charles Foulkes: A Primer on How to be CDS," in Bernd Horn and Stephen Harris, eds., *Warrior Chiefs: Perspectives on Senior Canadian Military Leaders*, (Toronto: Dundurn Press, 2001), pp.219-225
 37. For an overview of these efforts, see Donald Avery, *The Science of War: Canadian scientists and Allied military technology during the Second World War* (Toronto: University of Toronto Press, 1998); Jason S. Ridler, "Emergence: Toward a Historiography of Canadian Defence Research Efforts during the Second World War," Unpublished paper, 2004.
 38. Most scientists had joined the war effort with vigour, but with the Axis defeat in the summer of 1945 most wanted to return to civilian and industrial sectors of research. Mackenzie was also keen on a new defence research organization because there were alarming indications from the files of Soviet defector Igor Gouzenko that NRC members were actually Soviet spies, including Canadian physicist Alan Nunn May, who had worked at both the Montreal Lab and the Manhattan project. See Avery, *The Science of War*, pp.203-228; "Allied Scientific Co-operation and Soviet Espionage in Canada, 1941-1945." *Intelligence and National Security* 8, no. 3 (July, 1993), pp.100-128, Richard Rhodes, *Dark Sun: The Making of the Hydrogen Bomb* (New York: Touchstone, 1995), pp.127-8, 150-2, 159, 182-3, 375; D. J. Goodspeed, *A History of the Defence Research Board of Canada*. (Ottawa: Queen's Printer and Controller of Stationary, 1958); A.M. Pennie, "The Defence Research Board: A Quarter Century of Achievement," *Canadian Defence Quarterly* 1 no. 4 (Spring 1972), pp.6-15; A. M. Fordyce, "How it all Started: The Goforth Paper," *Canadian Defence Quarterly* 1 no. 4 (Spring 1972), pp.15-16.
 39. Gordon Watson, "Defence Research Board: Policies, Concepts, and Organization," in Law, et al, eds, *Perspectives in Science and Technology: The Legacy of Omond Solandt*, pp.61-74.
 40. Grenville, p.4.
 41. UT OMS B93-0041/033 File 4, letter from Mackenzie to Solandt, 20 March 1956.
 42. For the full story of the US divestment of their wartime atomic partnership with Canada and the UK, see Margaret Gowing, *Independence and Deterrence: Britain and Atomic Energy, 1945-1952: Volume I Policy Making* (London: MacMillan Press, 1974), pp.63-209
 43. Robert Bothwell, *Eldorado: Canada's National Uranium Company* (Toronto: University of Toronto Press, 1984).
 44. See notes 42 and 43. Also, Medical Directorate of the Canadian Army, *Medical Aspects of Atomic Warfare* (Ottawa: King's Printer and Controller of Stationary, 1948); Defence Research Board of Canada, *The Effects on An Atomic Bomb Explosion on Structures and Personnel* (Ottawa: King's Printer and Controller of Stationary, 1951).
 45. John Lewis Gaddis, *The US and the Origins of the Cold War* (New York: Columbia University Press, 1972; reprinted in 2000), pp.282-352.
 46. UT OMS B93 0041 /033 /File DRB Addresses 1946-1947, "Address by Dr. O.M. Solandt to the Voluntary Health Committee in the House of Commons, Ottawa, 24 April 1947," p.1.
 47. Ibid.
 48. Ibid.
 49. Ibid.
 50. Ibid., p.4
 51. Ibid., p.5
 52. Ibid.
 53. Ibid. Indeed, during his time with the DRB, Solandt exhibited a dour sense of humour about nuclear weapons, likely as a coping mechanism.
 54. Ibid., Emphasis added.
 55. Ibid, p.9
 56. Ibid., p.10
 57. Ibid., p.10A.
 58. Ibid.

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