



CRACKERJACK

An Air Defence Exercise, November 1955

Donald A. Grant
ORBITA Consultants Limited

The scientific or technical validity of this Contract Report is entirely the responsibility of the Contractor and the contents do not necessarily have the approval or endorsement of Defence R&D Canada.

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September 2012

Defence R&D Canada
Centre for Operational Research & Analysis

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Defence R&D Canada – CORA

Contract Report

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Abstract

This report was originally intended to focus on an aircraft crash incident which involved two operational research analysts from the Operational Research Analysis Establishment, National Defence Headquarters, Ottawa, Ontario. These analysts were flying in a Royal Canadian Airforce aircraft (a Canso amphibian) along the coast of British Columbia to brief the personnel at radar stations and a fighter aircraft base on a forthcoming air defence exercise, called “Crackerjack”. The personnel at these sites were being instructed on the general outline of the exercise, and they were asked to collect and record various types of information during the Crackerjack exercise. This information involved radar target detection, target tracking, intercepting the targets and the amount of cross – telling to adjacent radar and fighter aircraft.

Résumé

À l’origine, le présent rapport devait porter principalement sur un événement d’écrasement d’aéronef qui a mis en cause deux analystes en recherche opérationnelle du Centre d’analyse et de recherche opérationnelle du Quartier général de la Défense nationale, à Ottawa (Ontario). Ces analystes volaient à bord d’un aéronef de l’Aviation royale canadienne (un amphibie Canso) le long de la côte de la Colombie-Britannique afin d’informer le personnel des stations radar et celui d’une base d’avions de chasse de la tenue prochaine d’un exercice de défense aérienne appelé « Crackerjack ». Les analystes devaient fournir au personnel de ces emplacements un aperçu général de l’exercice, et le personnel devait recueillir et consigner divers types de renseignements au cours de l’exercice Crackerjack. Les données devaient notamment porter sur la détection de cibles radar, la poursuite de cibles, l’interception de cibles et la quantité de renseignements transmis aux radars adjacents et aux chasseurs.

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Executive summary

CRACKERJACK: An Air Defence Exercise, November 1955

Donald A. Grant; Sam Woodend; DRDC CORA CR 2012-232; Defence R&D Canada – CORA; September 2012.

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The timing of the Crackerjack exercise was a secret until the exercises occurred. The Crackerjack exercise was the first major exercise to occur upon the completion of the major land-based radars in the USA and Canada. This radar coverage in Canada was called the Pine Tree Line, and it was completed in January 1, 1955. Sixteen of these radar sites were staffed by Canadians in Canada and it was our Operational Research task to brief these staffers about Crackerjack.

As the DEW Line and the Mid-Canada line did not exist at this time, the incoming Strategic Air Command (SAC) were able to begin their southerly run starting in the mid-Canada region. Over the sea radar surveillance began in 1945 so the incoming aircraft had to start at least 300 miles from the coast.

The main purposes of Crackerjack was to obtain an assessment of the present (late 1955) state of radar coverage i.e. detection, tracking and interception. It was also important to evaluate the human performance in detection, tracking, cross-telling and fighter interception. The cross-telling was a critical factor, and it meant that all detections made by humans had to be shared with the adjacent radars. That is why we (the OR (Operational Research persons) possessed numerous forms to give out to persons at the radar sites. The emphasis was the collection of data for use in future studies involving the air defence of North America. In addition to the operational research persons, there were a significant number of scientists and systems analysts observing and collecting data on this exercise. The Mass. Institute of Technology (MIT) paid particular attention to the Crackerjack exercise. The MIT and its Lincoln Labs had an advanced set of systems for improving the air defence of North America. MIT was involved with the SAGE system. The Semi-Automatic Ground Environment (SAGE) was an automated control system for tracking and intercepting enemy bomber aircraft, the system could automatically direct aircraft to an interception by sending instructions directly to the aircraft’s autopilot.

In the late 1950’s the SAGE system and NORAD began their activities. So there was much attention to what kinds of results were derived from Crackerjack.

Sommaire

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Donald A. Grant; Sam Woodend ; DRDC CORA CR 2012-232 ; R & D pour la défense Canada – CARO; septembre 2012.

À l'origine, le présent rapport devait porter principalement sur un événement d'écrasement d'aéronef qui a mis en cause deux analystes en recherche opérationnelle du Centre d'analyse et de recherche opérationnelle du Quartier général de la Défense nationale, à Ottawa (Ontario). Ces analystes volaient à bord d'un aéronef de l'Aviation royale canadienne (un amphibie Canso) le long de la côte de la Colombie-Britannique afin d'informer le personnel des stations radar et celui d'une base d'avions de chasse de la tenue prochaine d'un exercice de défense aérienne appelé « Crackerjack ». Les analystes devaient fournir au personnel de ces emplacements un aperçu général de l'exercice, et le personnel devait recueillir et consigner divers types de renseignements au cours de l'exercice Crackerjack. Les données devaient notamment porter sur la détection de cibles radar, la poursuite de cibles, l'interception de cibles et la quantité de renseignements transmis aux radars adjacents et aux chasseurs.

L'horaire de l'exercice Crackerjack devait demeurer secret jusqu'au moment du déclenchement de l'exercice. Il s'agissait du premier exercice important du genre depuis la mise en place de l'important réseau de stations radars terrestres aux États-Unis et au Canada. Cette couverture radar au Canada portait le nom de réseau Pine Tree, et elle avait été terminée le 1^{er} janvier 1955. Seize de ces stations radars étaient exploitées par du personnel canadien au Canada, et le Centre d'analyse et de recherche opérationnelle avait pour tâche de communiquer à ce personnel certains renseignements à propos de l'exercice Crackerjack.

Puisque les réseaux d'alerte radar des lignes DEW et Mid-Canada n'étaient pas encore en place à cette époque, les aéronefs en rapprochement du Strategic Air Command (SAC) pouvaient amorcer leurs vols en direction sud à partir de la région du Centre du Canada. La surveillance radar au-dessus de la mer ayant commencé en 1945, les aéronefs en rapprochement devaient partir à au moins 300 milles de la côte.

Les principaux objectifs de l'exercice Crackerjack étaient d'obtenir une évaluation de l'état de la couverture radar en vigueur (vers la fin de 1955) au niveau de ses capacités de détection, de poursuite et d'interception. Il était également important d'évaluer le rendement des ressources humaines au niveau de la détection, de la poursuite, de la transmission des données et de l'interception par les chasseurs. La transmission des données était un élément essentiel, et cela signifiait que toutes les détections effectuées par des humains devaient être communiquées aux stations radars adjacentes. C'est pourquoi nous (les analystes de la recherche opérationnelle (RO)) avons à distribuer un grand nombre de formulaires au personnel des stations radar. Une attention particulière était accordée à la collecte des données devant servir dans des études à venir portant sur la défense aérienne de l'Amérique du Nord. En plus des analystes RO, il y avait un nombre important de scientifiques et d'analystes de systèmes qui observaient et recueillaient des données sur cet exercice. Le Massachusetts Institute of Technology (MIT), notamment, accordait une attention particulière à l'exercice Crackerjack, car cet établissement et son Lincoln Laboratory avaient mis au point un ensemble de systèmes évolués visant à améliorer la défense aérienne de

l'Amérique du Nord. Le MIT avait notamment participé à la mise au point d'un système semi-automatique d'infrastructure électronique (SAGE) qui était un système de commande automatisé pour la poursuite et l'interception des bombardiers ennemis. Le système pouvait diriger automatiquement un chasseur vers l'aéronef à intercepter en transmettant directement des instructions au pilote automatique du chasseur.

Le système SAGE et le NORAD sont entrés en fonction à la fin des années 1950. Il y avait donc beaucoup d'intérêt à l'égard du type de résultats que l'on pouvait obtenir de l'exercice Crackerjack.

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1 Introduction

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In the late 1950’s the SAGE system and NORAD began their activities. So there was much attention to what kinds of results were derived from Crackerjack.

2 Canadian Operational Research Participation

A number of scientists from Ottawa and Washington and officers from the Canadian and American Air Forces were assigned to study and evaluate the current effectiveness of the air defence system of North America. The evaluation teams from Canada and USA were assembled at Colorado Springs (the future of NORAD, the North American Aerospace Defence Command).

Most of the participants were already engaged in planning and participating in various aspects of the defence of North American against attack. This included work on radar sites, airborne early warning aircraft, fighter bases, missile defences, communication systems, and control centers in the USA and Canada.

Occasionally, the various systems, which were part of the defence of North America, were tested to see if each unit could do their job. Such a test was planned for the autumn of 1955. At this time, I had become a planner and an analyst for air defence systems. Defence officials in the USA and Canada decided to have “live-test” of all air defence systems covering North America. So as indicated, a planning and a working meeting was held in mid-November at Colorado Springs, Colorado, USA. Several Air Force Officers and Defence Research Board scientists (doing operational research) were assigned to this evaluation exercise called “Crackerjack”.

For many of us this was our first visit to Colorado, and on our weekend off we took a tour in the foothills of the Rocky Mountains below Pike’s Peak. Some of us were struck with the beauty of the Colorado blue spruce. My roommate, a fellow analyst from the hotel where we stayed, was so taken by the beauty of the blue spruce that he somehow acquired a baby blue spruce (about one foot high). I was not aware of this – I first discovered this tree soaking up water in our hotel room toilet, but only after I had used the facility. You see it was dark, so all I could do was shake it and put it back in its life giving place.

3 On With the Task – Interrupted by an Aircraft Crash

During the next week in Colorado Springs, we completed the planning for “Crackerjack” and we were instructed to brief the air defence units involved. Three of us were assigned to brief radar units and a fighter squadron in Western Canada. We flew to Vancouver, British Columbia and we had been told that an RCAF aircraft was assigned to take us from Vancouver to some of these radar units.

Mr. Sam Woodend, Flight Lieutenant Don McNicol, and myself formed our team. Sam was a member of the Defence Research Board Operational Research Establishment, where I was also a member. Flight Lieutenant McNicol was a jet fighter pilot.

From Vancouver we were taken by RCAF transport, a Consolidated Canso flying boat, to Tofino airport (on the west coast of Vancouver Island, BC) and we began our work at the Tofino radar station. We spent the night of November 22nd at Tofino and the next day was so “socked in” that we could not fly until 2pm on the 24th of November 1955. We headed to Port Hardy to brief the radar station in Holberg.

Here is Sam Woodend’s account of our trips from Colorado Springs to Tofino, and the trip to Holberg, which was interrupted by our aircraft’s crash in the water between the British Columbia coast and Vancouver Island. Each surviving passenger’s account of the crash is different as each passenger was “on his own” immediately after the crash. So here is another person’s viewpoint of the crash and subsequent events. Each passenger and crewmembers (who survived the crash) each had a different story to tell. My own views follow those of my colleague Sam Woodend.

4 Sam Woodend's Comments

Sam's comments on the technical aspects of an aircraft crashing into water require careful reading.

“Don Grant and I and a Flight Lieutenant Don McNichol formed our team. The latter was a jet jockey (CF-100s) who was temporarily suspended from flying for medical reasons, probably sinus, and he had been attached to OR. He had a degree in something, probably Mech Eng. The three of us flew by commercial airlines from Colorado Springs to Seattle and then to Vancouver. From there we transferred to RCAF transport, a Consolidated Canso flying boat. We flew around the south tip of Vancouver Island and up the west coast to the radar station at Tofino. We set up the recording system there, stayed the night, and started off the next morning for Holberg, with additional six or so airmen who were being transferred for the exercise to that station. Holberg was almost on the North tip of the island, and would normally have been reached by flying up the coast of the island crossing over at Port Hardy to Coal Harbour on an inlet entering from the west coast, and then flying up the inlet to land on the water at its tip, near Holberg.

We crossed over from the west to the east coast, over the mountains, and descended near Comox to a very low level, due to the increasing cloud. We flew north between the island and the mainland, being forced lower and lower by the descending clouds. When we were approaching Johnston Strait we were flying at about 80 feet, or so my memory tells me.

As we came up to the bend in the strait a rainsquall obliterated the forward view, and posed the pilot with a considerable problem. He knew that he was approaching a bend, but could not see it. High mountains on both sides of the water hemmed him in and presumably he knew that the aircraft could not climb fast enough to clear the unseen mountains ahead. He apparently elected to land straight ahead. He put the aircraft in without putting down the wing floats or announcing his intentions, probably because he did not have time to do either. The aircraft must have hit the water rather fast (were the flaps down? – I do not think so), and he did a ‘water loop’. In a ‘ground loop’ the aircraft swings sideways out of control while at speed on the landing roll-out, because if the pilot of a conventional undercarriage aircraft lets the swing start, and it becomes sufficiently severe, it may be impossible to stop it because the center of mass is behind the point at which the decelerating force is applied, i.e. the main wheels. The same thing can happen to a flying boat, if the center of water drag is ahead of the center of mass, a situation in which I assume results from landing in a nose-down attitude. The result was that the Canso slued over on its starboard wing tip, which dug in at the same time that the nose dug in. The aircraft tried to stand on its nose with a starboard hit. The nose ripped off just about the pilot's cabin, the aircraft righted itself and sank in about one minute, but only to the level of the wings. That is, the fuselage was submerged, but the wings and the tip of the tail were still above water for some hours. The aircraft of course had a ‘parasol’ wing, mounted on a pylon some six feet above the fuselage.

Don Grant had been sitting in a compartment ahead of mine, just under the stowage bulge of the port landing gear. McNichol was in my compartment, just aft of me. We had been sitting on a sort of bench built into the hull along the starboard side. I was right up against the bulkhead that separated our compartment from Don Grant's. I do not think any of us had seat belts. There were

none, or very few. Don Grant and I had been issued inflatable life jackets, but McNichol had not or at least did not wear it.

As the Canso tilted to the right and suddenly decelerated I was jammed, or jammed myself up tight against the bulkhead, with my right shoulder just behind an empty bracket that was intended for holding a JATO (Jet-Assisted Take-Off) bottle. The strain was very great indeed, and I assumed that we had had it. However, I managed to keep from coming adrift by a considerable effort, and I can still remember my relief as I felt the forces come off and the aircraft begin to settle on an even keel.

As this was going on I saw the port wheel well collapse and a great Niagara Falls of water engulf Don Grant. I assumed that that was the end of him. At the same time McNick was flying through the air, passing through the passageway in the bulkhead into Don G's compartment.

As we settled I headed for the fuselage door. It was a sliding door, which replaced the blister that would have been on the armed version of the aircraft, and it had a complex method of operation. I tried to open it but could not. There was quite a little group of passengers around it at this time. I heard the airman in charge of loading etc, LAC Fatt (LAC = Leading Aircraftsman, about a lance-corporal) tell everyone to be calm, and he came up and slid back the door, and everyone scrambled out. Unfortunately, just at this point McNick shouted to me from the forward compartment that he needed help. I can remember that I had no enthusiasm at all for being helpful at this stage. I just wanted to get out. However, there was nothing for it, so I went back and gave him a hand to get to the door, and I put my lifejacket on him, as he did not look as if he would be much good at swimming. In fact, his right arm had been mangled when he landed on it after his aerial transfer from the rear compartment to the forward one. I stood him at the door while I scrambled out and got up onto the wing and reached back and hauled him up. In fact he was doing a lot to help. I can remember breaking through the fabric of the control surfaces with my feet. In that era even metal aircraft had fabric-covered control surfaces.

With McNichol safely on the wing I look around and saw the pilot staggering aft across the wing, having just arrived on it from somewhere forward. It was a large wing. He did not look well, and I saw that one of his legs was twisted in an odd direction. As it seemed likely that we would all be in the sea shortly after the aircraft sank, I decided that the pilot should be made capable of being moved, so I set about to splint his leg. There was no splinting material available, so I lashed his broken leg to his 'good' leg, with neckties. I found some months later that both legs had been broken.

We all watched with interest as the water level climbed up the tail and wing, and were relieved when we seemed to stop sinking.

During these activities Don Grant appeared, dressed in his overcoat, with a Lee-Enfield rifle slung over his shoulder, swimming behind the port wing. I suggested that he drop the rifle, and it presumably is still in the bottom of Johnston Straight. We then hauled him in, and he was clearly in a bad state of shock, so we wrapped him in as much material as we could find. This was considerable, as a number of kit bags had floated up from the fuselage. Eventually he explained to me that he had come to underwater in the fuselage, and had swum to the rear of where he dimly remembered the exit to be. He missed it, as it was the slanting hatch, which would have been over his head, and he came to a door opening into a rear compartment, and opened it. He encountered

the Lee-Enfield, and believing that it was an emergency situation, and it would be well to be armed, took it, and eventually found his way to the exit hatch.

I was not overly impressed with the effort of the crew, however the co-pilot did make some attempt to direct operations, but did not very effectively. He did suggest that people collect the kit bags so that they could be used as floats when we sank. My memory being unfair however, because the flight engineer (a sergeant) and LAC Fatt were in fact very helpful. Of the rest of the crew the pilot was in severe physical and mental shock, and had two broken legs, the co-pilot did try, and must have had a rough time getting out, and the navigator and the radio operator were both dead. We did a check and found that there were two airmen missing also, and to my knowledge, none of the bodies were ever found.

When we were established on the wing one of the first questions was where was the life-raft. The flight engineer said it was in a locker aft of the rear compartment, and he dove back into the water and entered the submerged fuselage and brought the raft out! A very good effort. The raft was a large round fabric inflatable, for ten men. Just what we needed. The flight engineer pulled the yellow emergency knob that allowed the compressed nitrogen to flow from the storage bottle through a rubber tube to inflate the raft. There was a spurting sound and the tube went flying rapidly into the atmosphere. This was depressing, but LAC Fatt, who must have been a fine airman, said we would blow it up by mouth and started to do so. He made several ineffectual attempts to get up some pressure in his blowing, before we discovered that he had cut in his cheek was leaking air badly. The sergeant took over and did get some air into the raft. It might have been some use, but I am glad we did not have to try it.

After some time, perhaps 30 to 40 minutes, a floatplane turned up and we transshipped Don Grant to be flown directly to the hospital. He was in shock and I remember laying the law down to everyone about keeping him warm. However, at about the same time, a 'fish packer' arrived. It was a ship with a barge in tow, whose job it was to pick up fish from fishing vessels. It had seen our crash and had turned its barge loose (that must have been a difficult decision in the wicked currents of Johnson's Strait) and had come directly to our help. The captain later explained that he owed the RCAF something from helping him in an emergency in the past. We had some trouble dissuading him from coming alongside our semi-floating aircraft and thereby possibly sinking it.

They were wonderfully helpful people. They gave us blankets and we put the injured in berths (only the pilot, McNichol and one airman I think). I missed the pilot and went looking for him and found him lying on the floor of the engine room, where everyone had forgotten him. McNichol's arm was obviously in bad shape, and he wanted to get his uniform jacket off. I whipped out my trusty and even in those days, very sharp pocket knife, and proceeded to cut it off. However, McNichol said it was his best #3 uniform, and it was not to be cut. I took it off him in the normal way, and it must have been very painful. His arm had been broken in some six places. The nerves had been severed, and that may have made things easier.

We started to steam for Campbell River, and were met on the way by an RCAF crash launch, containing a very battered doctor. They were high-speed boats and must have been rough to travel in, and it had been a long trip from Comox. We bussed from C River to Comox and were hospitalized there. Even me, although I had nothing but a twisted ankle. I stayed for several days in the hospital, mostly from inertia, and because McNick and Don Grant were still in legitimately. Don had almost died on the X-Ray table when he was first admitted.

I mentioned to someone in authority that we had been carrying classified material on our tour, and that it had gone down in our briefcases in the aircraft. They had been recovered by the next day by divers. That must have been quite a feat. When Don Grant opened his briefcase he took out a brand new 8mm movie camera that he had brought in Colorado Springs. There was a disgusting green froth oozing from it. The slide-rule that I had prided myself on was in my case. The plastic coating was curled back from the boxwood interior, and it was obviously finished. In due course, I listed it among the things for which I claimed compensation, and received \$25 for it. I threw it in a drawer when I got home, to keep as a souvenir of an exciting incident. Several years later I took it out and noticed that the swelling of the wood had decreased markedly. Several years after that I had returned it to its original form, and I still use it on occasion. I did not find it necessary to return the \$25 after the passage of so much time” – Sam Woodend.

5 Survivor's Comments

When the crash occurred all passengers and the aircraft crew were “on their own” during the seconds and minutes following the crash. Each survivor had his own unique experience. Regrettably two members of the crew and a passenger met death and were not seen again.

Comments on the crash were solicited from each survivor by the crash investigation team. Some of their comments are repeated in the following pages.

5.1 Comments by the Co-pilot

“The captain put on power and hit the indicator light. We were now almost touching down and the captain and I both picked up our microphone and yelled ‘floats down’ to the engineer. At almost the same instant we contacted the water with considerable force. The next thing I remember was a series of bangs on the hull and a sound like breaking glass and I thought that the aircraft lurched to the starboard. I then experienced a sinking sensation and the water rose up to my neck. I released my harness and looked for my mae west, but discovered that I did not have it on. I tried to get up but as I did, I felt something bind my left foot and I could not free it. As the nose of the aircraft sank, I went under water and my foot became free. The next thing I remember is climbing up to the starboard propeller over the engine on to the aircraft starboard wing. I then stripped off my parka and right flying boot, but was unable to get the other one off as the zipper was damaged. Somewhere about this time I remember hearing F/O Sutcliffe weakly yelling ‘help, help!’ I then helped pull someone up on to the center section of the wing over the leading edge. At this point the aircraft was floating with only the main planes and the tail section above the water. The water was calm to the point where no one had any difficulty in maintaining their footing and there was no water washing over the wing. I remember someone counting the personnel on the wing and it was eventually determined that three people were missing.

Q: To what extent did you pull F/O Sutcliffe’s leg to re-splint it?

A: F/O Sutcliffe was conscious and asked me if I could straighten out his leg. I gently straightened the leg and did not try to pull it out to length and then applied two boards as splints with the assistance of Cpl Toombs. We seemed to collide with the water with considerable force. As I remember it, there appeared to be a harsh grating sound and a feeling that we were in solid contact with the water. Pounding was experienced with fairly rapid deceleration. The aircraft appeared to break up almost immediately.

Q: Did you notice if there was any drift or crab just prior to touching down?

A: If any, I believe there was a slight drift to starboard.

Q: After contact with the water, did you experience any sudden change in direction or swing?

A: A can't recall experiencing any violent swing except I felt a lurch to starboard just prior to the aircraft settling under water.

5.2 Comments by the Pilot

“The aircraft ploughed nose first into the water and water gushed in. I saw the windscreen in front of me shatter. The next I remember was being completely under water and everything was quiet. I unfastened my safety harness and reached over my head to open the escape hatch, but do not remember coming in contact with anything except the visor which I moved out of the way. I then pushed myself to the surface of the water. I climbed on to the wing via from the port engine. I climbed up on to the wing via the port propeller hub and was gratified to see the number of people on the wing. I do not remember anyone climbing up after me. Cpl Toombs jumped back into the water to retrieve the dingy, which was still in its place in the aircraft. The dingy was pulled up on to the wing.

5.3 Comments by a Leading Aircraftsman

“There followed a severe vibration which shook the whole aircraft. I then felt myself being pitched forward, slightly at first, but with increasing force I knew the nose was digging in and I could hear the loud rush of water. I was thrown forward in, and came to rest facing the tail. I noticed that the floorboards in the living compartment were out of place. I picked myself up and proceeded to the blister. I remember that I had to go up hill. Arriving in the blister I saw Mr. Woodend attempting to open the cargo door. I opened the cargo door and hesitated for a moment thinking about getting the dingy out of the aircraft. Realizing I would obstruct the others method of exit, I left the aircraft and climbed up on the wing. When I left the blister there was no water in it. I can't remember if there were others on the wing when I got there. I recall F/O Sutcliffe clambering up on the inboard side of the port engine over the leading edge of the wing. I also recall assisting someone pulling Mr. Grant up on the trailing edge of the wing immediately above the fuselage”.

Q: When did you first realize that your face was cut?

A: While we were attempting to inflate the dingy.

Q: Can you remember striking anything during the crash?

A: No.

5.4 Author's Comments

The seventh witness Mr. Donald Alton Grant having been called and duly sworn states:
“I am Mr. Grant, Donald Alton, employed as a Research Scientist, Defence Research Board, National Defence Headquarters, Ottawa Ontario.

I was assigned duty to visit the West Coast RCAF units. On the 22nd of November, 1955 I went from Sea Island to Tofino in a Canso aircraft. We remained there until the afternoon of November 24th when we took off for Holberg. At take-off I was sitting on the port side of the engineer's compartment and remained there throughout the flight. I was wearing a mae west but was not wearing a seatbelt, as there was none provided in this position. The crewman told me that we had carried out a letdown at Comox and we were proceeding to Holberg. Some minutes later I noticed that we were flying quite low and the air was rough. I noticed the land from time to time. The next impression was that it became exceedingly rough and some people became sick. I had to hold on to them to avoid banging myself against some parts of the aircraft. I noticed that the RO was strapped in and seemed to be pitching around from side to side although he continued to send messages. F/L McNichol and Mr. Woodend were looking out of the starboard blister and I noticed them suddenly sit down and Mr. Woodend grabbed hold of something, which gave me the impression that something was going to happen. The next thing that happened was a fairly smooth touch down on the water for a very brief second then we became momentarily airborne again. Then the nose appeared to go down and there was a violent crash and the next impression was water coming in. I remember being thrown but I don't know how far, and the next impression was I was on my feet proceeding towards the aft of the aircraft. About half way back I had the impression that I was under water and that I was not going to get out. I was striving to get to the port cargo door, which was the only exit I was familiar with. I saw the light of the opening and left the aircraft by that door. The next thing I remember I was at the wing and it was at water level. I remember having difficulty climbing up on the wing and Mr. Woodend helped me up. Mr. Woodend placed me on my back where I had considerable difficulty breathing and was coughing up a lot of blood and salt water. Shortly after I was placed on my back, I requested Mr. Woodend to inflate my mae west, which he did. I was not sure where I was or why I was there, and I asked Mr. Woodend these questions. I remember the following people on the wing of the aircraft: Mr. Woodend, F/L McNichol, and LAC Flatt. The next thing I recall is being carried along the deck of the tugboat. I think I remember everything from there on. Sometime later I was taken from the tugboat to a Canso and flown to Comox".

A: I can say yes to everything with the exception of the latter question referring to action to be taken in case of emergency.

Q: Who gave you this information?

A: The pilot and crewman.

Q: Were you given a similar briefing prior to departure from Tofino?

A: I don't remember a similar briefing but I do recall the passengers were requested to come forward in the aircraft.

The survivors had to find an exit from the fuselage or it was filled with water. Three of the survivors found themselves already in the water or they were in the nose area, which broke off when the crash occurred. Thirteen water soaked individuals found a hatch and one could see daylight through the water, and it was our only opening visible. Going forward in the crashed aircraft was not possible because the area where the nose broke off was a jumbled mess of metal (see photograph). The nose broke off immediately in front of the wheel well, (a couple of feet from where I was sitting).

5.5 Being in Hospital

After I got to the hospital in Comox my friend Sam told me that I surfaced in the water just behind the wing with an Enfiled rifle slung over my shoulder. I was not aware of this extra item, but it apparently came from the rear of the aircraft where it was stored. On the aircraft's impact the rifle was launched from the rear of the aircraft and wound its sling around my neck. So I had extra baggage when I found the hatch and a way out. So I still wonder how I was able to survive to the floating wing. It must have been about my last gasp. Anyway, several persons reached out and pulled me onto the floating wing where I was not able to stand up. (I had to get rid of a considerable quantity of water and blood from fractured ribs. At one point I was described as being in "a confused state".

The crash occurred on 24 November 1955. Then I spent a week at the hospital in Comox and as soon as I could walk I was transferred to an Air Force hospital in Base Rockcliffe, Ottawa, Ontario where I spent another week mainly to allow my ribs to heal and to knit back together again.

Apparently a cast for healing ribs is a medical no-no, so the ribs are left to heal on their own. This procedure helps to ward off pneumonia so the patient has to move more about very gingerly. You soon discovered the motions which produced excruciating pain. This pain was usually accomplished with the noise of broken ribs grinding each other. The ribs take about 7-8 days to stop their grinding, and that was a bit of solace for the soul.

6 Back to Work on Crackerjack

Just before Christmas 1955, I was able to go back to work and continue on the analysis of air defence exercises. The analysis of the large continental air defence exercise “Crackerjack” began in January 1956. So I was back on the job at Operational Research, DND, Ottawa, Ontario.

The Canadian results from Crackerjack were analyzed by a group OR analysts based in Ottawa and in St. Hubert, P.Q. The results were soon coordinated with OR analysts in the USA as indicated previously in this paper; the main deficiencies were in the detection phase, the tracking phase and the interception of the incoming bombers. Coupled with these problems the most serious problem was the coordination of all activities between the radars and sector control. All of these actions were the responsibility of the human operator. It was obvious that these operators needed some kind of assistance. At that 1955/56 time the SAGE system (Semi-Automatic Ground Environment – see Introduction) was being developed and we encountered several representatives from MIT and its laboratories during and after Crackerjack. It was probably obvious to most experts in air defence that the present (1955) system needed a generous and effective boost. At that time the SAGE system was the leading candidate. It continued to be a main contender as there was very little else to choose from. So SAGE was further developed and its deployment began in 1958. In the same year the NORAD agreement was signed in May 1958, and in June 1961 the groundbreaking ceremony was held at Colorado Springs. In the meantime (in 1956) two Canadian Operational Research Analysts were assigned to the Pentagon to help in the establishment of SAGE and NORAD. The postings to the Pentagon were to an office known as the Canadian US Scientific Advisory Team (CUSSAT). The duties of the Canadians in CUSSAT were to provide technical help in the establishment of NORAD and SAGE.

The CUSSAT was located in the “Planning” activity in the U.S. Defence Headquarters. We at CUSSAT had up-to-the-minute briefings on matters bearing on North American defence. We also continued to participate in North America air defence operations and exercises. There were a number of important studies and exercises in the late 1950s and early 1960s.

- (a) A series of air defence exercises called WEXVA1 was organized in the Pentagon to test SAGE and NORAD facilities. The duty of CUSSAT was to ensure adequate Canadian participation. (An outline of the SAGE system is contained in Annex B). The organizing unit WSEG (Weapons, Systems Evaluation Group) and it reported to the Secretary to Defence. This group contained scientists from MIT and other U.S. universities.
- (b) By 1958 it was realized that the ICBM would take over from the bomber threat. By 1959 CUSSAT was asked to assess the ICBM threat, this project was completed and briefings by myself and a U.S. colleague (E. Meyer) to representatives of the Secretary of Defence Office and RAND Corporation including Herman Kahn. These briefings and others with a similar result lit some fires beneath those inclined to do arms control studies.

Another interesting study during the CUSSAT days was an analysis of concepts of using satellites for navigation (SATNAV) at this time the U.S. had not launched their first satellite.

While I was at CUSSAT there was no time to twiddle one's thumbs. Upon my departure (July'61) my friends at the Pentagon gave me a card stating that 29,999 people left in the Pentagon would miss me.

7 Lessons Learned

- When a dangerous situation is suspected, grab on to something solid.
- When you are under water for an unusually long time, you may not be able to judge the difference between life and death.
- Exercises Crackerjack established that there were substantial gaps in performance in various parts of the North American air defence system, and conclusions were reached that a necessary amount of automation would lead to a cure of this systems shortcoming. So SAGE was called up and an installation began. By the time that 1959 rolled around there were fears that the North American air defence system were to be soon outflanked by the ICBM.
- The SAGE system gave a very significant boost to the computer industry – all beyond the financial abilities of most countries. SAGE would have benefited by using transistors, but SAGE was about 10 years too early to benefit.

Annex 'A' The Crashed Aircraft

The Canso aircraft before it crashed. The retrieved crashed Canso. The sitting locations of the passengers.

(The photographs and diagrams could not be scanned, but they are available from the author if needed).

Annex 'B' The SAGE System

The SAGE System (Partly from Wikipedia)

By the time SAGE was completely operational, the Soviet bomber threat had been replaced by the Soviet missile threat, for which SAGE was entirely inadequate. Nevertheless, SAGE was extremely important; it led to great advances in online systems and interactive computing, real-time computing, and data communications using modems. It is generally considered to be one of the most advanced and successful large computer systems ever developed.

Both MIT and IBM supported the project as contractors. IBM's role in SAGE (the design and manufacture of the AN/FSQ-7 computer, a vacuum tube computer with ferrite core memory based on the never-built Whirlwind II) was an important factor leading to IBM's domination of the computer industry.

A massive building program started along with continued work on the computer systems and communications, with the first groundbreaking at McChord AAFB in 1957. The buildings were huge above-ground concrete bricks that were often placed near cities without the residents being aware of what they were. The first SAGE Division became operational in Syracuse, New York in January 1959, and by 1963 the system was already complete with 22 *Sector Direction Centers* and three similar *Combat Centers*. When NORAD was set up another site was added at CFB North Bay in Canada, although in this case the entire SAGE system was buried approximately 700 feet (210 m) underground in what became known as "the hole".

The total engineering effort for SAGE was immense. Total project cost remains unknown, but estimates place it between 8 and 12 billion 1964 dollars (60-90 billion 2011 dollars), more than the Manhattan Project that developed the nuclear bomb that SAGE defended against.

The AN/FSQ-7 is physically the largest computer ever built, and will likely hold that record for the future. Each machine used 55,000 vacuum tubes, about ½ acre (2,000m²) of floor space, weighed 275 tons and used up to three megawatts of power.

The SAGE system was operational until 1983, when it was replaced by newer systems and airborne control. The North Bay system ran until 1983 when it was dismantled and sent to *The Computer Museum* in Boston. In 1996 the remainder was moved to Moffett Federal Airfield for storage and it now is in the collection of the Computer History Museum in Mountain View, California.

Questions about the ability of the SAGE system to actually handle a "hot war" situation were continuous. On one occasion SAC was able to penetrate the defenses, and on other occasions huge flocks of seabirds were tracked as a potential bomber attack. A more serious problem was that by the time the system was fully operational, the USSR had already started deploying ICBMs, making SAGE largely useless.

To protect against the possibility of SAGE sites being disabled and possibly rendering the defence impotent, the Air Force also developed the Back Up Interceptor Control System (BUIC), a sort of mini-SAGE located at some of the radar sites that normally fed the SAGE system.

In peacetime SAGE was, for all intents, an air traffic control system and it influenced the design of the FAA's automated control systems. The system also gave IBM valuable insight, and it was not long after that the CEO of American Airlines met one of the IBM people involved in SAGE by accident on a flight, and soon the two companies were developing the SABRE airline reservation system.

Other major SAGE developments included:

- CRT-based real-time user interface
- use of wide-area communications via modems
- the installation, operation, and logistic support of over 100 long range radar stations located throughout the U.S. as part of the Air Defence Command

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This report was originally intended to focus on an aircraft crash incident which involved two operational research analysts from the Operational Research Analysis Establishment, National Defence Headquarters, Ottawa, Ontario. These analysts were flying in a Royal Canadian Airforce aircraft (a Canso amphibian) along the coast of British Columbia to brief the personnel at radar stations and a fighter aircraft base on a forthcoming air defence exercise, called "Crackerjack". The personnel at these sites were being instructed on the general outline of the exercise, and they were asked to collect and record various types of information during the Crackerjack exercise. This information involved radar target detection, target tracking, intercepting the targets and the amount of cross – telling to adjacent radar and fighter aircraft.

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