Field Notes: Challenges and approaches for collecting recent material heritage of science and technology

Notas de Campo: Desafios e abordagens para a coleta de patrimonio material recente de ciencia e tecnologia

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Abstract: At the Canada Science and Technology Museum, we have been putting more emphasis on collecting and researching recent material heritage. There are enormous challenges associated with size and scope, geographical coverage, ownership, privacy, complexity of components, tracing supply chains, transportation, available storage space, decisions about significance, proprietary knowledge, safety, preservation, and objects that are opaque and inaccessible to the untrained eye. In this paper, I cover a variety of case studies of contemporary collecting and the strategies we are developing to turn these challenges into opportunities for research and sharing.

Keywords: Contemporary science, collecting, science museums, material heritage.

Resumo: No Museu de Ciência e Tecnologia do Canadá, temos priorizado a coleta e pesquisa de artefatos do patrimônio material recente. Existem imensos desafios associados com as dimensões e o alcance, a cobertura geográfica, a propriedade, a privacidade, a complexidade dos componentes, o traçado de cadeias de fornecimento, o transporte, espaço de armazenamento disponível, as decisões sobre significado, conhecimento sobre o proprietário, segurança, preservação e objetos que são opacos e inacessíveis para o olho destreinado. Neste artigo, eu abordo uma variedade de estudos de caso de coleta recente e as estratégias que estamos desenvolvendo para transformar esses desafios em oportunidades para a pesquisa e compartilhamento.

Palavras-chave: Ciência contemporânea, coleta, museus de ciência, patrimônio material.

1. Introduction - Inside the Black Box

In the spring of 2014, I learned about a “Surgical Black Box” developed at St. Michael’s Hospital in Toronto and used in a surgical theatre. The surgical black box records data, audio and video during a surgical procedure in the same way that an aviation black box records cockpit data during a flight. The lead physician Dr. Teodor P. Grantcharov intends to use this data for learning purposes, but also to make surgical procedures more transparent (VETTOREL, 2014). It is a bold and novel practice that takes aim at traditional notions of surgical culture, tacit expertise and authority.

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I set out to collect the surgical black box, but ran into practical, research and museum challenges. First, the box is still in use and will not be available until the second system is ready for trial. Second, from a museum or public display point of view, these kinds of black boxes seem remote, abstract, mysterious, boring, and not human. Third, a key aspect of this object relates to immaterial features such as software and coding, as well as huge amounts of memory, storage and data. Fourth, this object is called a "black box," but it is also a classic black box as in the name given to a kind of post-WWII technology where all the key parts (knowledge) are hidden, inaccessible, imbedded and taken for granted for the average user[1].

How do we deal with this kind of black box problem? Is there a way to study this object from a critical, cultural and human perspective? Is it too difficult to bring this kind of object into a museum context?

I read about the surgical black box, but had actually not seen one. It was neither shown in the popular reports, nor in the technical publications. The first research surprise, therefore, is that the box is not black - it is blue. This fact is as surprising as seeing an original aviation black box in our museum collection, which is in fact a fluorescent orange[2]. There is much for us to unpackage culturally about colour and instruments, the choices made by makers, users, marketers, and what these choices tell us about the function of colour in contemporary science and technology.

The second feature that stands out about this object is the maker - PESA, a communications technology company that specializes in streaming massive audio and video data[3]. PESA is a high-tech company located in the Huntsville, Alabama military-industrial sector. A large portion of their products provide surveillance needs for industry, government and military. This technology, therefore, carries a specific technological, military and cultural context into surgical practice.

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[1] The classic articulation of the Black Box comes from Latour (1987). More recently science museum curators have struggled with the black box as an object for display, research and teaching. (MAAS, 2013). On the broader topic of preserving the recent heritage of science, see the special issue of *Studies in History and Philosophy of Science* (JARDINE, 2013).

[2] Royston MIDAS A.I.D.S. Container. Canada Science and Technology Museums Corporation, artifact no. 1986.0273.

[3] PESA's website states the following: "As a leading provider of audio/video (A/V) Baseband and IP connectivity products, PESA offers a wide selection of multi-path streaming products, routing switchers, matrix switchers, extenders, converters, media extenders, and signal processing gear to support government, military, industrial, commercial, medical, broadcast, and mobile truck applications. From large to small-scale A/V routing and extender products to multiple IP streaming appliances, PESA offers a diverse suite of AV products, all of which are supported by 24/7 technical support. PESA is located in Huntsville, Ala., with regional sales offices throughout North America and China. Our cost effective solutions are available around the world through our industry leading team of Channel Partners offering local support and installation." Source: PESA website accessed March 31, 2015 http://www.pesa.com/about-us/

I have yet to examine the inside of the PESA instrument, but like many similar technologies, this unit would have parts and components designed and made in locations around the world. Each chip, button, chassis and wire has been made, assembled, inspected by someone or a group of people. It would have a complex manufacturing history and social context independent of its uses. Researching the human and geographical context of its production, though not related to its primary function, would provide many stories for sharing/explaining in museum exhibits and display. Who actually made this box? What do we know about the everyday routines, lives and work of these people? Would it be worthwhile to visit the actual sites of production to document the local and human story behind its creation?

Through the above questions and research, we can penetrate the black box critically on social, economic, labour, and most importantly very human terms. We can show that this blue box comes into the surgical theatre from multiple contexts, and brings embedded values, practices and knowledge into medical practice. In the following paper, I show how this critical approach for collecting recent science and technology can open new possibilities for research, teaching and exhibits. Through several case studies, I hope to illustrate that immersive, creative curatorial fieldwork is one of the best ways to get inside the black box.

2. What are the major challenges with collecting science and technology?

There are a number of significant challenges related to collecting recent science and technology:

- Collecting criteria. Some of the criteria we use for historical collecting does not apply in the present. Do we need new criteria for contemporary collecting? For example, there is a strong materiality literature in science and technology studies (STS) as well as philosophy of science that is becoming increasingly mixed with curating[4].

- Physical Inaccessibility. Many contemporary objects are located in remote locations, are tied down by complex intellectual property issues, are still being used as prototypes, and have very high transportation and shipping costs.

[4] There have been several recent workshops and conferences that have combined materiality scholarship with curatorial work. Materiality: Objects and Idioms in Historical Studies of Science and Technology, May 2-4, 2013, York University, Canada. https://materialityconference.wordpress.com/ "It's Not what You Think: Communicating Medical Materialities" Medical Museion, Copenhagen, Denmark, March 8-9, 2013. http://www.museion.ku.dk/itsnotwhatyouthink/ The Medical Museion has a strong tradition of mix scholarship, curating and contemporary science and technology (DAVIES, 2015).

- Size. Some instruments and systems are simply too large to collect (e.g. particle accelerators). How do we decide what to collect from the large instruments? What is essential?

- Global objects. How do we research the history of a contemporary object that represents a vast global distribution of design, testing, manufacturing and use?

- Materials and safety. Recent technologies use new materials with unknown dangers and untested preservation over time.

- Immaterial dimensions. How do we develop strategies for collecting and preserving the seeming immaterial dimensions of software and coding?

- Lack of documentation. Many contemporary objects are not accompanied by digital information related to production and use.

- Space. Constant changes, removal, creation of new spaces at scientific institutions

- Lack of human connections. Through the media and a variety of science communications, we tend to learn about recent technologies as generalized objects, lacking meaningful connections at local and human scale.

In this section, I shall focus in more detail on just three of the above challenges related to size, materials and safety.

2.1 - Size: Collecting an aircraft and a community

Canada is a large country. Similar to Brazil, we have a special historical relationship with surveying, exploration and mapping. In recent years, we have been exposed to striking multi-coloured depictions of our territory in the form of remote sensing satellite maps. These images are embedded in the popular imagination about Canadian geography and natural resources. They became popular following the launches in 1995 and 2007 of the highly successful Canadian RADARSAT satellites that map the earth from space. What are the technologies and processes behind the making of these images? How do we preserve them for the museum and the public?

The key technology or instrumentation for RADARSAT is the synthetic aperture radar (SAR), a form of radar that builds images of the earth. In 2012 we were offered equipment from the airborne remote sensing program that preceded the satellite technology. The instruments and radar antenna had been used in a 1950s Convair 580 airplane. We set out to preserve a small selection from the key radar equipment.

However, following several visits to the aircraft hangar, examining the instruments in situ and interviewing the people who used the aircraft and equipment, we ended up becoming interested in acquiring the entire plane and scientific equipment as an integrated scientific vessel.

Figure 1 - Convair 580 at the hangar of the Geological Survey of Canada. Photo by author, 2014.

The Convair Model 580 is a member of a successful family of medium range airliners built shortly after the end of the Second World War (GRADIDGE, 1997). The U.S. Air Force used several version that proved quite successful. Following the 1950s, several companies converted more than 250 “Convairliners” into turboprop airliners. As well, Montréal-based Canadair Limited built ten aircraft for the Royal Canadian Air Force. Several dozens Convairliners, converted or not, are still flying today in Canada and abroad. Operated by more than 375 airlines in sixty countries over many years, they are among the most successful medium range airliners in history. However, we saw the aircraft as something with a unique scientific heritage within this traditional aviation context.

Even though we have an Aviation and Space Museum, the acquisition of an aircraft was an unusual move that raised significant challenges related to preservation, historical interpretation, storage, and conservation. In order to pass this acquisition proposal through a rigorous acquisition process (even tougher due to the size of the proposal), Renald Fortier, my curatorial colleague from the Aviation and Space Museum, and I argued that we needed this aircraft for the following reasons: First, we did not have an aircraft in the collection that had such a strong history of being used for scientific research. Several of our aircraft had connections to military work, surveying, and applied research in aviation technology, but none were used essentially for scientific research. We argued that we needed this kind of aircraft in the national collection to preserve the deep connections between science and aviation. Second, the aircraft was the bridge between the earlier bush planes used for surveying and mapping and the later remote-sensing satellites. The Convair 580 aircraft was the pivotal airborne test platform that led to space-based remote sensing (SHEPHERD; KRUCHIO, 2008). Third, we saw the aircraft as similar to other vessels in the history of science. This was an opportunity to collect a “Beagle” with all its social and material dimensions for the remote sensing field. Fourth, the aircraft had a remarkable provenance and geographical history of use – it was once a Johnson and Johnson executive aircraft, was bought by the government of Canada, and flew in missions in dozens of countries for remote sensing studies in several disciplines from forestry to Arctic ice to agriculture to geology[5].

We passed the acquisition, but then we faced significant challenges related to ownership and space. The National Research Council of Canada owned the aircraft. They wanted to keep some newer valuable aircraft parts, so we agreed to swap the new parts for older parts from an earlier period in the aircraft’s history. This was a complex process with many challenges related to the historical integrity of the aircraft. We then needed space at our Aviation and Space Museum. As I write the aircraft is still at the hangar for the National Research Council of Canada; it will fly to the museum in the summer of 2015. At that time, we will still have to rotate planes in and out of storage for a short period, while at the same time taking conservation precautions for having some aircraft outside at times.

A further challenge is that the aircraft had not flown in over eight years. It had to be repaired and recertified to fly from the research hangar to the aviation museum landing strip. This challenge became an historical research opportunity. I was able to visit the crew as they worked on the aircraft, and in so doing, learn (and record) much more about the actual aircraft and its workings while gathering additional historical information.

[5] Unpublished CSTMC Acquisition proposal: “Convair Model 580 flying test bed and remote sensing aircraft,” March 24, 2014. Renald Fortier and David Pantalony.

I came to learn that collecting an aircraft, similar to any large-scale scientific project or instrument, was essentially about collecting a diverse community[6]. I had the benefit of being assisted by a retired scientist who organized (and is still conducting) interviews with former colleagues as well as gathering all the proper documents and photos related to the aircraft and its history. I usually do this myself for acquisitions, but the size of the community surrounding this object necessitated help in bringing this material together.

Figure 2 - The instrument racks and stations inside the Convair 580. Photo by author, 2014.

2.2 - New Materials

Increasingly, we are collecting objects made with new materials, or at least materials in new forms with unknown long-term stability. In 2007 on a visit to the Walter Reed Medical Centre in Washington DC, I collected a 3-D print of the skull of an American soldier wounded in the Iraq War c. 2004[7]. These 3-D prints are now common in military and civilian neurosurgery. They are used by surgeons to help make a plate to cover the wound.

[6] David Pantalony "Collecting an Aircraft and a Community." CSTMC Blog *Collecting and Connecting* accessed March 15, 2015. http://collect-connect.cstmcweb.ca/2014/04/collecting-an-aircraft-and-a-community/

[7] CSTMC Artifact No. 2007.0221.

Our conservation staff encounter several varieties of plastics dating back to the 19th century. Some of the materials are stable, others have crumbled, others change colour over time, and others leak residue onto other parts of equipment. The particular material of the 3-D skull is quite sensitive to light and has to be stored and exhibit carefully. Our head of conservation, Sue Warren, a specialist in the history of plastics, was concerned about this skull and its future prognosis if exposed to high levels of UV light. In her report from November 2012 she wrote the following: "According to the source (U.S. Army), the resin used to cast the skull is SI40 resin, and will embrittle over time especially when subject to UV light. Because the resin is light cured, excess light will hasten deterioration." The skull did not exhibit any "surface stickiness," she wrote, as "a previous resin used to cast these had an inherent problem with stickiness" (WARREN, 2012).[8]

Figure 3 - A "sample" model of a skull from the Walter Reed 3-D Imaging Center. The models are usually full size. They are generated from 2-D medical images (CT scans). This model, one-quarter size, was produced using SLA 7000 stereolithography system from 3D Systems, Valencia, CA, USA. Canada Science and Technology Museum, Artifact no. 2007.0221. Photo by author, 2014.

2.3 - Safety as a research opportunity

In some cases, an instrument carries an invisible, highly toxic material. This can present a dangerous (even fatal) situation if the collector does not interview one of the original users, or if the collector finds the instrument disconnected from its original context.

[8] Sue Warren, Conservation Report, Canada Science and Technology Museum Supplementary Information Files for Artifact no. 2007.0221, November 2012.

In 2014 we acquired a prototype instrument c. 1981 designed for detecting extra-solar planets. In the early 1980s, Canadian astrophysicists Dr. Gordon Walker, Stephenson Yang and Bruce Campbell developed a spectrographic technique that employed a Hydrogen Fluoride absorption-cell and gas-handling unit in conjunction with telescope observations (WALKER, 2012; CAMPBELL, 1988). This instrument led to the development of instruments for detecting hundreds of extra-solar planets by scientists worldwide (BERKOWITZ, 2012).

The original instrument, however, had highly toxic Hydrogen Flouride residue inside. We had to contract someone to clean the HF cell before even arranging shipment. As with all the above challenges, this problem became a historical opportunity. We had to research how the HF was used in the operation of the instrument. It turned out to be the key element in the process (WALKER, 2012). A conservation danger became a good explanation opportunity.

Figure 4 - Part of the Hydrogen Fluoride (HF) absorption cell and gas-handling unit, c. 1981. Now in the warehouse at the Canada Science and Technology Museum. Photo by author, 2104.

3. How do we collect and preserve recent science and technology?

There are several strategies and methods that contribute to effective and comprehensive contemporary collecting. At the Canada Science and Technology Museum we have a long tradition of using a research-based foundation for active collecting in the form of a Collection Development Strategy. We compliment this with collecting and research focus should fit patterns and strengths of collection. In addition to these rational intellectual and collection-based strategies, we embrace the non-intellectual dimensions of collection research using material culture approaches. All of these curatorial strategies are complimented through connecting across the country in the following ways: we are building disciplinary networks across the country for particular subjects; we have have embarked on intensive, immersive, curatorial fieldwork through targeted preservation/collecting trips; we have made use of interdisciplinary networks - HPST, STS scholars, artists, scientists to help with research and collecting; we are making the processes of transparent through a new curatorial blog called “Collecting and Connecting.”

3.1 - Planned collecting

At the Canada Science and Technology Museum we have a long tradition of research-based collecting. In the early 1990s we built a Collection Development Strategy (CDS) that was based on historical assessments (reports) on core subjects covered by the museum (CANADA SCIENCE AND TECHNOLOGY MUSEUM, 2006). For example, for subjects such as agriculture, astronomy, medicine, and computing we have contracted outside historians, experts in these fields, to write a historical report on these fields in Canadian history. These reports, mostly secondary literature surveys, are often the only such history from a Canadian perspective. The curator then uses these reports to develop a Collection Assessment of the area/subject based on what we actually have in the collection. The result is a combination of Historical Assessment and Collection Assessment.

We have found over the years that planned, active collecting must follow this solid research foundation. We also collect according to our collection strengths that often reflect larger Science and Technology (S+T) strengths of Canada as a whole. Canada, for example, has a strong reputation in nuclear physics and medicine. We were the second country to sustain a critical nuclear reaction in 1945. Due to the size of our country, we also have unique collection strengths in communications, transportation, natural resources, exploration and surveying. In the past five years we have added several research-based contemporary collecting initiatives to the CDS framework (ADAMEK, 2015).

3.2 - Beyond planning: Encounters with the sublime

Collection work is not all rational, however, and especially in contemporary collecting where there is not always obvious guidance from historical or collection assessments, we must trust the non-intellectual dimensions of being out in the field. What is surprising and fascinating to the informed curator in the field, may have great value for the collection and museum exhibits.

Some scientific facilities carry both deep heritage elements, as well as a compelling sensory experience that is worthy of noting and preserving. I found both of these elements during a recent visit to the new Accelerator Mass Spectrometer facility at the University of Ottawa. First, Canada has a long tradition in mass spectrometry with many surviving, but uncatalogued historic objects; in this case, I was hoping to preserve some of the recycled accelerator magnets that came from Canada's first nuclear research facility at Chalk River, Ontario (c. 1950s). Second, I felt challenges to document at least visually the remarkable setting. Upon visiting the facility, I was struck by the arrangement of the instruments, the open architecture (visitors can look into the lab in operation), and the beautiful spectral chart of nuclides on the floor. This is part spectacle and part pedagogy - professors bring students to the lab to use the chart on the floor. The scientists also use the pleasing environment to host tours of the public and visiting dignitaries.

Figure 5 - Accelerator Mass Spectrometer, University of Ottawa. Photo by author, 2104.

Figure 6 - The 200 Source Loader within the Ion Source Assembly in the new Accelerator Mass Spectrometry Facility at the University of Ottawa. Photo by Author, 2014.

In touring the facility, I was struck by the carbon source-loading trays, the work that went into making and arranging them, the work that went into preparing each sample, their centrality in the mass spec chain, and their beautiful symmetry.

On the historical side, there is one recycled magnet from the Chalk River facility, Canada's first nuclear facility (1945) that ended up not being used. We would be keen to acquire this historic magnet, but rather than bringing it back to storage which would require the contracting of a special truck and crew, we are going to leave it in situ as a loan. It will be part of the tour with our label and interpretation.

Figure 7 - Leftover, recycled magnet from Canada's earliest accelerator laboratory. This will now be part of the living scientific site with interpretation. Photo by author, 2014.

3.3 - Research, community building, immersive fieldwork

My visit to the Mass Spectrometry facility derived from a long and substantive research investment to connect and learn about this field in Canadian history. It was highlighted in our Historical Assessment for Canadian physics. But it also derived from my active involvement in the Canadian physics community. Through my participation on the heritage committee of the Canadian Association of Physicists (CAP), I was able to organize a special panel session on the history of mass spectrometry in Canada at the annual CAP congress. Several people participated from the past and present research; these sessions provided in-depth histories of people, instruments, places and industry.

It was from these sessions, and the connections made therein, that I was able to plan a research-based field trip to the University of Manitoba (U of M) in Winnipeg. The U of Manitoba has been a hub for mass spectrometry in Canada, and I wanted to go to the location, scout for artifacts and interview key players (SHARMA, 2013)[9]. The result has been the acquisition of a pivotal Time-of-Fight Mass spectrometer from the 1990s (STANDING, 2000).

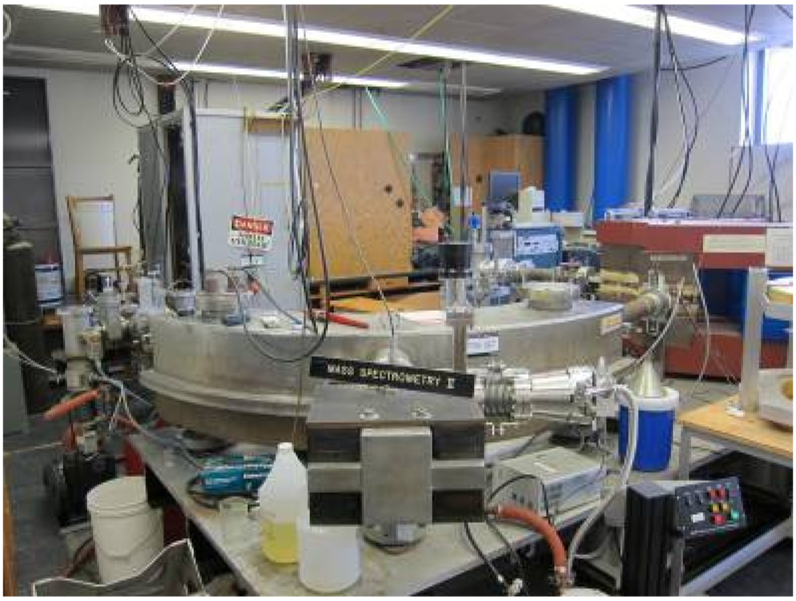

Figure 8 - The Manitoba II, Physics Department, University of Manitoba. Photo by author, 2014.

What can we actually collect? In the case of the mass spectrometry at U of M, we could not collect the most recent example as it was still in use. Following interviews

[9] For the early history of mass spectrometry see (NIER, 1998).

with main contributors, we decided upon an instrument that encapsulated a number of elements representing the development of this science and technology.

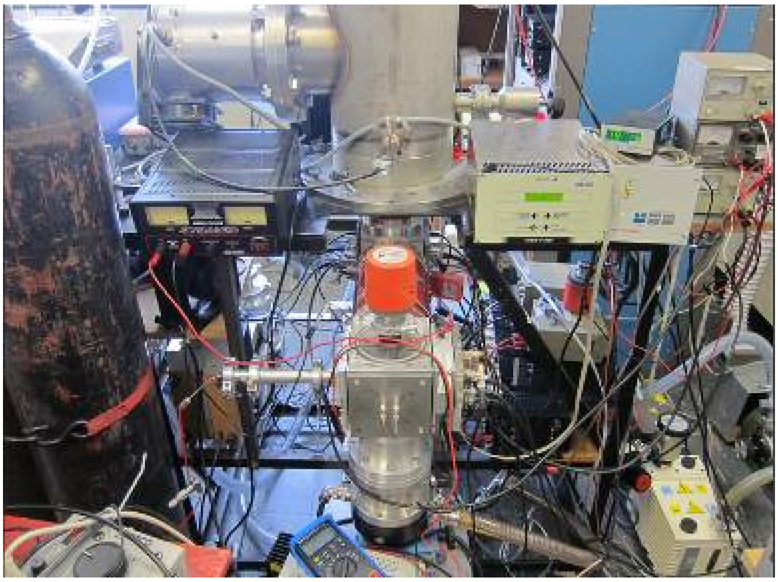

Figure 9 - Not available yet! Time-of-Flight Mass Spectrometer (TOF3) that is currently in use. Photo by author, 2014.

Figure 10 - Ken Standing with the second Time-of-flight Mass Spectrometer (TOF2). Photo by author, 2014.

Through in situ interviews, I was able to gather important information about practice in the lab, construction of the instrument, and social relations in the lab not found in published documents. Some of these notes appeared in a blog about my visit to The University of Manitoba[10]. Overall, the existing research at the museum, the symposium, as well as the fieldwork combined to build context for the eventual acquisition of the Time-of-Flight Mass Spectrometer (TOF 2) (Figure 10).

4. What historical and curatorial opportunities derive from these activities?

4.1 - Collecting and connecting

Contemporary collecting is about building relationships and communities. Our fieldwork and engagement with the practitioners and observers helps to build a network of connections in both the sciences and humanities. We are now integrating this approach into informal networks for various fields across the country; we have also started a museum blog “Collecting and Connecting” to share these experiences with our audiences. The first post was about my trip to Winnipeg [11].

Aside from the above focus on collecting and researching recent science, there are fruitful historical spin-offs from immersive fieldwork. A field trip I took to the Canadian Light Source (an accelerator synchrotron) at the University of Saskatchewan led to a surprise discovery of some valuable historic scientific instruments on campus, and subsequently a growing relationship with an overlooked, but historically significant region of the country. In the 1940s, 50s and 60s, Saskatchewan was a leading center for the arts, public policy, medicine and science, and yet we did not have that history well represented in the collection[12].

Through these trips, I was able to connect a historic spectrograph used by Nobel Prize winner Gerhard Herzberg, with our own collection of his later instruments (PANTALONY, 2013). In addition to the opportunity to examine this important instrument in the history of Canadian physics, I was able to learn more about the development of Prairie physics from the surviving instruments and archival records. There were surprises such as instruments made locally by F.W. Pye, a member of the

[10] David Pantalony, “Field Notes: Mass Spectrometry at the University of Manitoba,” Collecting and Connecting Blog, Canada Science and Technology Museums Corporation, http://collect-connect.cstmcweb.ca/2013/12/mass-spectroscopy-at-the-university-of-manitoba/ accessed March 31, 2015.

[11] Ibid.

[12] Background reading included: (CURRIE, 1976; O'BRIAN & MENDEL ART GALLERY, 1989; STOICHEFF , 2002; WAISER & PERRET, 2006)

famous Cavendish instrument-making family. In fact, it was clear from the uncatalogued collection that Saskatchewan had a strong instrument making tradition, which helped explain how the physics department achieved renown in several fields. There were many instruments that showed a strong North-South relationship between the department and scientists and makers in Chicago, Wisconsin and Milwaukee[13]. The usual relationship in Eastern Canada and the United States is East-West (e.g. Toronto – London).

Figure 11 - Herzberg spectrograph, c. 1937, University of Saskatchewan pictured with the Chair of Physics, Dr. Chary Rangacharyulu. Photo by author, 2014.

4.2 - Building context for big things

The large size of objects is one of the major challenges with contemporary collecting, but this can provide unexpected research opportunities. In 2003 we collected an early MRI machine from the Montreal Neurological Institute (MNI). The MNI has a national and international reputation for doing cutting-edge brain imaging

[13] David Pantalony, "Physics and the Modern on the Canadian Prairies," to be published in edited volume based on the conference *Science, Technology and the Modern in Canada: A Conference in Honour of Richard Jarrell*, April 24-25, 2015.

research. We wanted one of the early MRI machines to capture this important dimension of Canadian medical history.

Figure 12 - Arrival of MRI machine at the Canada Science and Technology Museum, Ottawa, 2003. Artifact Lot - AP0035. Photo Courtesy of Canada Science and Technology Museum.

The machine weighs several tons (the heaviest item in our medical collection) and required a truck to transport it from Montreal to Ottawa. It is also a complex piece of modern technology with hundreds of components designed and made by dozens of manufacturers distributed around the world.

However large, complex and overwhelming, the MRI was still made somewhere, and its materials come from somewhere. Therein lies the challenge – to find the places and people associated with the making of this huge medical object. The heart of the machine is a superconducting magnet, which produces images of the inner structures of the body. Similar to many of the specialized parts in the MRI, the magnet has a serial number, which allowed for detailed research into its design and production history. For example, I was able to trace the supply chain of its main ingredient, Niobium, back to CBMM mines in Brazil (PANTALONY, 2011). At every node of the Niobium supply chain, there seemed to be controversy, for example, the exposure of the Brazilian miners to radiation from radon gases in the mines (JULIÃO *et al*., 2007). This aspect of the machine raised labor and environmental issues that had nothing to do with the practice of medicine, but should be considered an important part of the history and values embedded in the technology.

4.3 - Building context for small things

Small things are as challenging as large things. In 2010 Canadian researchers created the world's first biosynthetic cornea, or a bio-engineered cornea that mimicked the growth in situ of a natural cornea. In the laboratory of Dr. May Griffith of the Ottawa Hospital Research Institute (OHRI), researchers moulded recombinant human collagen into the shape and consistency of natural corneas. These were then transplanted into patients at the Linköping University Hospital in Sweden (PER FAGERHOLM, 2010).

How do we collect something such as a small, clear bio-engineered lens? How do we display it? I went to interview researcher Kim Merrett about the making of these cornea. In order to capture the entire process, I invited our Artist-in-Residence, Robert Bean to document the laboratory and Merrett at work. We used this material as inspiration for a small exhibition, as well as documentation for the acquisition files. In the end, Bean's work high-lighted (and documented) in powerful and effective visual form the material processes of this kind of laboratory activity and (material) knowledge creation.

The actual cornea has to be preserved carefully in a saline solution and sealed container. We displayed it in a dark space with low intensity ultraviolet light to highlight the lens. The UV display as well as surrounding photographs and instruments from the laboratory provided drama to the small, barely visible biotech innovation.

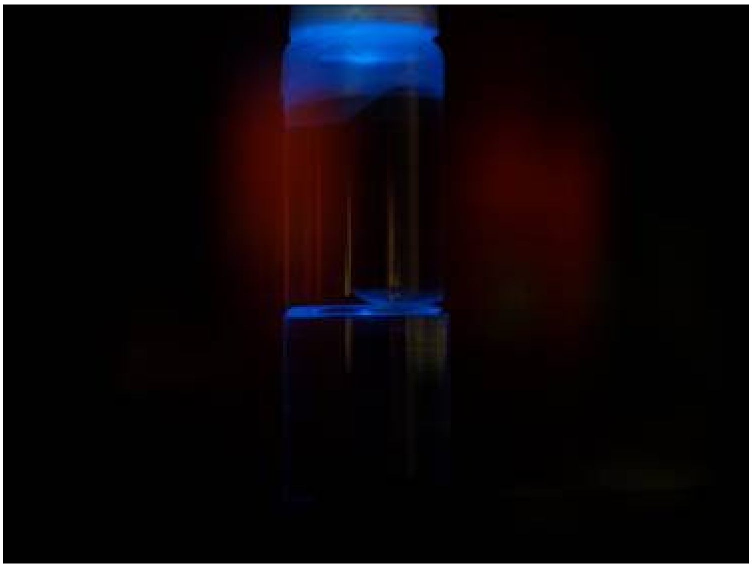

Figure 13 - Biosynthetic cornea made in the laboratory of Dr. May Griffiths, Ottawa Hospital Research Institute. Photo: Canada Science and Technology Museums Corporation, artifact no. 2010.0110. Photo Courtesy of the Canada Science and Technology Museum

4.4 - Finding the human story amidst shelves of equipment

In the last two years, colleagues and I have made several trips to the warehouse of the Canadian Space Agency (CSA) in St. Hubert, Quebec. We have been collecting scientific instruments that span the Shuttle era, 1981-2011 as well as Canadian experiments on the International Space Station (ISS). We have sifted through numerous containers of surviving equipment, supplies and instruments. We have also interviewed the main players involved in the scientific projects – scientists, instruments makers and engineers. In connecting the instruments and the people, we have gained an appreciation for dimensions of scientific practice that I had previously taken for granted.

Figure 14 - At the Warehouse of the Canadian Space Agency with graduate student Jordan Bimm from the York University Science & Technology Studies program (STS). Photo by author, 2014.

The instruments represent several disciplines from botany to material science to physiology, but they all relate to each other through one key variable – microgravity conditions. Ironically, taking advantage of these conditions requires years of preparation, planning, testing and design, duplication of equipment, substantial levels of conformance and verification, good funding and a space ship.

My curatorial colleague Michel Labrecque laid the research foundation with an historical assessment of Canadian science in space for the Shuttle and ISS. This included the main experiments, instruments, people and partner institutions across Canada. We made several visits to the warehouse during this research phase. For one of the warehouse sessions, we brought Jordan Bimm, a Science and Technology

Studies scholar (York University) who specialises in the history of space program in Canada and the United States. Bimm's presence helped provide needed perspective as we sorted through containers filled with instruments, parts, equipment and documents.

As we developed a formal proposal, I also interviewed the main players to get the human perspective on the experiments. I was struck in these interviews by the portrait of elegant, simple science that emerged. Doug Watt, a lead scientist for many successful experiments done by Canadians in Space, described his main challenge as keeping the experiments "as simple as humanly possible. Do an awful lot of testing in all kinds of circumstances." Not everyone could get time and space on the Shuttle or ISS. "No matter what you get, it will be new," he told me.

Walter Kucharski, the maker of many of the instruments for Watt's program at McGill, appreciated Watt's ability to ''keep experiments simple" and ask "simple questions." It takes years to plan, test and produce one set of instruments. He responded to Watt's basic scientific questions by building robust, simple instruments. In fact, he preferred older generation technologies that were often "one step back," but with proven performance. For Kucharski, a large part of their success came from working closely with the astronauts to train them, and listening carefully to their feedback.

Figure 15 - Containers for scientific instruments used by the Canadian Space Agency. Photo by author, 2014.

The instruments and well-worn containers display mission stamps, transportation logistics and inscriptions, extensive safety procedures, material and parts audits, supply chains, mission numbers, and calibration and quality control labels. The materials are space age circa 1970 to 2010 with foils, velcro, and plastics. The boxes and instruments have the smell of overly packaged instrumentation and supplies.

The whole enterprise of science in space has an overbuilt or overly-prepared quality. Scientists and instrument makers had to design the instruments to perform in remote, challenging conditions. “You may not get a second kick at the can,” Luc Levebvre, a project engineer at the Canadian Space Agency, told me during an interview about the acquisition. Levebvre described the need to “plan for science to be performed while you or grad student are not there” It is science in an “expeditionary mode.” You are not there, so the instruments and their whole operation have to be incredibly resilient.

The instrument designers are not just shaping equipment, they are masters of time-management. “Crew time is a precious commodity,” says Lebebvre. They had to design equipment that minimized complications and took into consideration launch delays and other time problems.

Some of the equipment trays have an Ikea meets Apple packaging look and feel. Simple, design equated to flawless execution. Lefebvre comments: “You have to use imagination to try to visualize how crew would interact with the equipment.” Even operations such as opening or sliding a lock could be complicated in micro-gravity. Latches, for example, may have to be designed to operate with one hand using a pinching motion. Relying on a typical push/pull application of force would require that the crewmember hold on with the other hand on supporting structure.

All of the above research, visits, findings, activities, collaborations, and interviews provided a sound basis for making the final selection of artifacts and archival material. The acquisition passed our committee, and the CSA delivered over ten pallets of materials in the fall of 2014. We have been able to apply the details of the research to the first phase of cataloguing the instruments.

5. Conclusions. There are multiple ways to get inside the black box

Contemporary science can seem complex, overwhelming and inaccessible. An immersive approach to collecting from multiple angles and perspectives produces surprising connections to human, material and local contexts. It demystifies science, and starts the process of breaking the whole into comprehensible parts.

In the preceding paper, I reviewed challenges related to size, materials, safety and black boxes. By engaging these challenges, one discovers unexpected research opportunities and narratives related to materials, construction, skills, aesthetics, modification, geography, business, conservation, globalization, local practice, social relations and other cultural and institutional contexts such as the military. By engaging the contemporary material world of science, we are also faced with inspiring curatorial and museological challenges and questions – what to keep and how to display it? How to penetrate the black box?

We have also learned that increased engagement with recent science informs the history of science and technology, as well as providing unexpected connections and lines of inquiry for future research and collecting. At the same time, many of the above case studies show that meaningful engagement in the fields of recent science and technology require a solid historical foundation.

There are a few key principles underlying contemporary collecting in practice – follow a sound research foundation, keep in mind the strengths of your museum's existing collection, use collecting to build diverse, interdisciplinary communities around a particular project, and be sure to get out in the field to observe the laboratories, facilities and scientists in operation. Collecting is an act of connecting. Getting inside the Black Box is about getting out into the field.

One of the more important benefits of contemporary collecting is that it starts the process of shifting critical attention towards the material culture and instruments of science. Popular discussions of science in the media often describe generic depictions of instruments as free-floating tools used by scientists without history of context. We must ground the material and historical dimensions of science in their own compelling human, social, aesthetic, environmental, material, design and geographic dimensions. This approach inspires new ways of sharing science with the public; it also allows us to share the beauty and reality of scientific processes.

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