Scientia Canadensis
Canadian Journal of the History of Science, Technology and Medicine
Revue canadienne d'histoire des sciences, des techniques et de la médecine

Photography: Science, Technology, and Practice in Nineteenth-Century Canada

Joan M. Schwartz

Volume 44, numéro 1, 2022

Photography: Science, Technology and Practice

URI : https://id.erudit.org/iderudit/1098144ar
DOI : https://doi.org/10.7202/1098144ar

Aller au sommaire du numéro

Éditeur(s)

CSTHA/AHSTC

ISSN

1918-7750 (numérique)

Découvrir la revue

Citer cet article

Schwartz, J. M. (2022). Photography: Science, Technology, and Practice in Nineteenth-Century Canada. *Scientia Canadensis*, *44*(1), 118–137. https://doi.org/10.7202/1098144ar

Résumé de l'article

S’appuyant sur la recherche empirique d’un projet plus vaste sur la photographie en Amérique du Nord britannique au XIXe siècle, cet essai part de la conviction que la photographie – en tant que science, technologie et pratique – mérite d’être examinée de plus près pour les façons dont elle a contribué à la création et à la circulation des connaissances au Canada, du milieu jusqu’à la fin du XIXe siècle. Cette incursion dans les histoires entremêlées de la photographie, de la science et de la technologie se fonde sur les images qui ont survécu ainsi que sur celles qui ne sont connues que dans les documents écrits, et a pour but d’ouvrir de nouvelles orientations pour les études à venir des historiens des sciences et de la technologie..

Photography: Science, Technology, and Practice in Nineteenth-Century Canada

Joan M. Schwartz

Abstract: *Drawing upon empirical research from a larger project on photography in nineteenth-century British North America, this essay proceeds from the conviction that photography—as science, as technology, as practice—warrants closer scrutiny for the ways in which it contributed to the creation and circulation of knowledge in mid-to-late nineteenth-century Canada. Based on surviving images as well as those known only from the written record, this foray into the entwined histories of photography, science, and technology, while far from comprehensive, is intended to open up new directions for further study by historians of science and technology.*

Résumé : *S'appuyant sur la recherche empirique d'un projet plus vaste sur la photographie en Amérique du Nord britannique au XIXe siècle, cet essai part de la conviction que la photographie – en tant que science, technologie et pratique – mérite d'être examinée de plus près pour les façons dont elle a contribué à la création et à la circulation des connaissances au Canada, du milieu jusqu'à la fin du XIXe siècle. Cette incursion dans les histoires entremêlées de la photographie, de la science et de la technologie se fonde sur les images qui ont survécu ainsi que sur celles qui ne sont connues que dans les documents écrits, et a pour but d'ouvrir de nouvelles orientations pour les études à venir des historiens des sciences et de la technologie..*

Keywords: 19th century, Canada, Photography, Science, Technology

On 10 May 1839, *The Colonial Pearl,* a Halifax newspaper "Devoted to Polite Literature, Science and Religion," published news of "THE NEW ART OF SUN PAINTING." In a few paragraphs, sandwiched between descriptions of "Hall's Patent Paddle-Wheels" designed to remove "the distressing and injurious tremour in steam-vessels" and "New Lamp for Light Houses" capable of delivering "superior light" at considerable savings, Haligonians first learned about pictures "taken, in the ordinary manner, with the camera obscura," not as art in aesthetic terms but in practical terms alongside other technological advancements. The author pointed to the competition between France and England for "the honour of this new invention," noted that Louis Jacques Mandé Daguerre's process was still secret, and summarized a paper on "photogenic drawing" presented by William Henry Fox Talbot to the Royal Society, London: "Nothing can be more perfect than the image it gives of leaves and flowers, especially with a summer's sun, the light passing through the leaves, and delineating every ramification of their nerves."[1]

Two weeks later, *The Colonial Pearl* reprinted an article from *The Magazine of Natural History* by botanist Golding Bird "on the application of the photogenic art to botanical purposes."[2] To the newspaper's delight, Bird's detailed description prompted a reader to try his hand at Talbot's process:

 Joan M. Schwartz, "Photography: Science, Technology, and Practice in Nineteenth-Century Canada," *Scientia Canadensis* 44, no. 1 (2022): 118-128.

> PHOTOGENIC DRAWING.—We are glad to find that our notice of the new-art of sun painting in our last [issue] has excited considerable interest among our readers. One of our friends who read the article has since formed several photogenic pictures with ease and success. And by following the directions contained in the article alluded to, any person may make natural objects delineate themselves, without the aid of the artist's pencil.[3]

This amateur effort may well be the first instance of experimentation with the new medium in British North America; however, it did not take long before "photography"[4] became a topic of discussion among leading scientists of the day at the Canadian Institute in Toronto and the Natural History Society in Montreal.[5]

This essay presents empirical research from a larger project on photography in nineteenth-century British North America. It proceeds from the conviction that photography —as science, as technology, as practice — warrants closer scrutiny for the ways in which it contributed to the creation and circulation of knowledge during a formative period of Canadian nation-building.[6] It highlights that some photographs were taken as raw data for rigorous study, measurement, comparison, and analysis; others were produced as visual arguments. Some contributed to the pursuit of scientific knowledge in their day; others have accrued scientific significance in the fullness of time. And it is through studio likenesses that we know what the distinguished (mostly) men and (a few) women of Canadian science looked like.

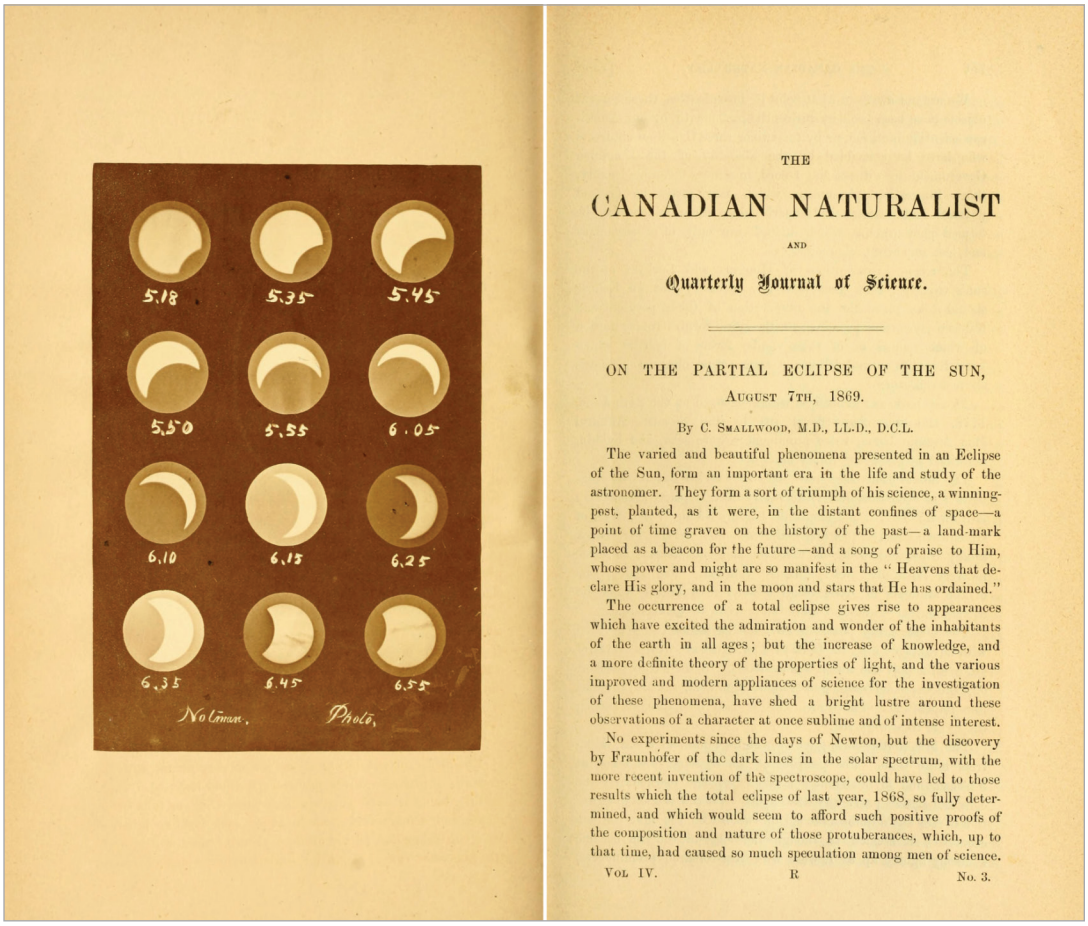
This foray into the entwined histories of photography, science, and technology is based largely on surviving images, but, citing examples of photographs known only through written sources, it also demonstrates that there is more to photo-historical research than meets the eye. It combines archival emphasis on functional origins and authorial intention with academic approaches to photographic representation, context, and meaning. Far from comprehensive, it draws attention to some of the many photographs created or employed in scientific pursuit and technological advance in British North America in the mid-nineteenth century. Ultimately, it is intended to highlight research opportunities as yet not fully pursued and open up directions for further study by historians of science and technology.

Astronomy

A description of the Royal Magnetic and Meteorological Observatory in *Rowsell's City of Toronto and County of York Directory for 1850-1* reveals that, as early as 1850, photographic technology was harnessed to collect raw astronomical data for comparison and analysis:

> It is probably the most complete establishment of the kind at present in existence as regards its instrumental equipment; and, in addition to sets in duplicate of the common *magnetometers* ..., it has recently been provided with the costly and beautiful instruments by which those changes are *self-recorded*, by being made to impress the position of the magnets belonging to them at every successive instant of time, upon silver plates prepared after the process of the daguerreotype, or on fine paper rendered sensitive to light by the calotype process.[7]

Such photographic plates supplied quantifiable data; they were read rather than viewed, used for calculation rather than contemplation. Not surprisingly, they have not survived. Here, our knowledge of this application of photographic technology to the pursuit of astronomical science in Canada comes, not from surviving visual images but from evidence of photographic practice in the written record.



THE

CANADIAN NATURALIST

AND

Quarterly Journal of Science.

ON THE PARTIAL ECLIPSE OF THE SUN,
AUGUST 7TH, 1869.

By C. SMALLWOOD, M.D., LL.D., D.C.L.

The varied and beautiful phenomena presented in an Eclipse of the Sun, form an important era in the life and study of the astronomer. They form a sort of triumph of his science, a winning-post, planted, as it were, in the distant confines of space—a point of time graven on the history of the past—a land-mark placed as a beacon for the future—and a song of praise to Him, whose power and might are so manifest in the "Heavens that declare His glory, and in the moon and stars that He has ordained."

The occurrence of a total eclipse gives rise to appearances which have excited the admiration and wonder of the inhabitants of the earth in all ages; but the increase of knowledge, and a more definite theory of the properties of light, and the various improved and modern appliances of science for the investigation of these phenomena, have shed a bright lustre around these observations of a character at once sublime and of intense interest.

No experiments since the days of Newton, but the discovery by Fraunhofer of the dark lines in the solar spectrum, with the more recent invention of the spectroscope, could have led to those results which the total eclipse of last year, 1868, so fully determined, and which would seem to afford such positive proofs of the composition and nature of those protuberances, which, up to that time, had caused so much speculation among men of science.

Figure 1. *William Notman, twelve timed phases of an eclipse, on a single albumen print, hand-tipped onto a blank page, to accompany Charles Smallwood, "On the Partial Eclipse of the Sun, August 7th, 1869,"* ***The Canadian Naturalist and Quarterly Journal of Science,*** *IV, 3 (September 1869): 249-256.*

In 1860 and again in 1869, Professor Charles Smallwood of the McGill College Observatory enlisted the services of pre-eminent Montreal photographer William Notman to obtain photographs of solar eclipses. An original albumen print showing a timed sequence of twelve phases of the 7 August 1869 event, obtained over a period of an hour and 37 minutes, accompanied Smallwood's article in *The Canadian Naturalist and Quarterly Journal of Science* (**Fig. 1**). In his text, Smallwood recounted how Notman:

> exposed a collodion plate to the sun, moving it forward every five minutes, to show the effect of the sunlight on the sensitive surface. A like exposure of sensitive paper was made at the Observatory, with remarkably similar results. A piece of chromotype paper was there also exposed in a similar way, and formed a complete photometer scale, showing the action of the sunlight in the production of photographic effects.[8]

Notman's multiple-exposure plate made it possible to observe simultaneously, on a single photograph, what was not visible to the human eye: twelve, precisely timed stages of the eclipse.

For Smallwood, the photographs were a way to study "those interesting phenomena which may justly be deemed physical and astronomical, apart from those which may be

termed photographic, which, indeed, are only of a secondary and less important character." While readers were advised that "a deduction in every case of three minutes from the time noted in the accompanying photographs" had to be made, they were assured that "in other respects, they are a most faithful and reliable delineation of the various phases of the eclipse." To ensure that the images were understood correctly, Smallwood explained that, "In the accompanying photographs, the light part represents the Sun, the dark projections upon its disk the portion of the moon showing the amount of eclipse at the time marked underneath each."[9]

Whereas Notman's visual record of the 1869 eclipse circulated widely throughout the scientific community in the journal of the Montreal Natural History Society, his photographs of the 1860 eclipse were long assumed lost.[10] A set of these images re-surfaced in 1998 in *Reminiscences of North America*, an album acquired at auction in Toronto by the then National Archives of Canada (now Library and Archives Canada).[11] Compiled in 1861 by Thomas Evans Blackwell, Managing Director of the Grand Trunk Railway from 1857 to 1861, the album contains nine, separate albumen prints on a page titled, "Eclipse of the Sun, Montreal, Wednesday 18th July 1860."

Geology

The application of photography to the study of geology in Canada can be traced to observations made by Charles Lyell in his *Travels in North America in the Years 1841-2; with Geological Observations on The United States, Canada, and Nova Scotia*. In that text, he noted that "some Daguerreotype representations of the Falls [at Niagara] have been executed with no small success" and commented:

> They not only record the form of the rocks and islands, but even the leading features of the cataract, and the shape of the clouds of spray. I often wished that Father Hennepin could have taken one of these portraits, and bequeathed it to the geologists of our times. It would have afforded us no slight aid in our speculation respecting the comparative state of the ravine in the 19th and 17th centuries.[12]

Here, Lyell expresses the popular conception of the photograph as a way of seeing across time and space, as a marker of change, and as a baseline for study, measurement, and comparison. These applications played a part in what Charles O'Brien later called "one of the most contentious issues in nineteenth-century geology."[13]

For some 30 years after it was first shown to William Logan in October 1858, a specimen initially presumed to be a foraminiferal fossil was at the centre of a controversy over its purported organic origins and the beginnings of life on Earth. Later named *Eozoön Canadense*—"the dawn animal of Canada"—by William Dawson, it attracted the attention of the international scientific community, including Lyell and Charles Darwin. When the papers delivered to the Geological Society (London) in November 1864 by Logan, Dawson, T. Sterry Hunt, and William B. Carpenter were later published in the *Quarterly Journal of the Geological Society of London* and reprinted in *The Canadian Naturalist and Geologist*, Dawson illustrated his paper, with a "Nature-printed section of a specimen of *Eozoon Canadense* from Petite Nation Seigniory."[14]

In September 1874, when Dawson returned to Côte St. Pierre—the site on the Ottawa River "whence some of the most instructive specimens of *Eozoon* were obtained"—

Figure 2. *Plate III. "Weathered Specimen of Eozoon Canadense (one-half natural size). From a Photo by Weston, to face Chap.3," in J.W. Dawson,* ***The Dawn of Life ; being the History of the Oldest Known Fossil Remains, and Their Relations to Geological Time and to the Development of the Animal Kingdom****, (Montreal : Dawson Brothers, 1875).*

photography was enlisted to deliver up evidence in support of his claims. He was accompanied by T. C. Weston of the Geological Survey, "a skilful collector, ... who has had much experience in preparing and examining specimens of *Eozoon*, ... and subsequently prepared slices and photographs of some of the specimens obtained."[15] Dawson then used Weston's photographs (see figure in the Introduction to this issue) as the basis of illustrations in several publications, including *The Dawn of Life,* which he dedicated to Logan (**Fig. 2**).[16]

Dawson acknowledged that Alfred Selwyn, Director of the Geological Survey of Canada, supported his use of photography and permitted Weston to accompany him. Selwyn had earlier embraced photography for scientific study, when, as Director of the Geological Survey of Victoria, Australia, he hired Richard Daintree to produce photographs of coastal rock layers and outcrops, which were then used to map the geology of the state and create stratigraphic elevations.[17] Later, he authorized Benjamin Baltzly of William Notman's studio to accompany the 1871 Geological Survey of Canada party through the interior of British Columbia, in order "to secure accurate illustrations of the physical features of the country and of other objects of interest which may be met with during the exploration."[18] In his survey report, Selwyn "repeatedly referred to the photographs as he described the geological formations and commented on the terrain."[19] Although satisfied with the photographs from the 1871 expedition, Selwyn later declined a suggestion "that the Survey should establish its own photographic department to carry on the work more efficiently," claiming that he did not feel justified in making such "an expensive addition."[20]

Survey Photography

As an integral part of government-sponsored geological, boundary, and railway surveys that fanned out across North America in the second half of the nineteenth century, photography was put to the test in the field as a tool of scientific observation and record. The use of wet-plate technology — and even dry-plates — to take photographs under the trying conditions of survey work attest to the documentary aims and expectations of those who commissioned, created, and published them. In 1858, Humphrey Lloyd Hime took photographs on the Assiniboine and Saskatchewan Exploring Expedition led by Henry Youle Hind. Two years later, James Richardson used photography to record geological features in a traverse of the north shore of the St. Lawrence and along the coast of Newfoundland. In the 1870s, in addition to Baltzly's work on the 1871 GSC expedition through British Columbia, Charles Horetzky produced photographs on Canadian Pacific Railway survey expeditions through the Canadian west.[21]

By the late 1870s, when George Mercer Dawson led a Geological Survey of Canada party through British Columbia, smaller cameras and commercially available dry-plates that did not require darkroom preparation immediately before and after exposure allowed him greater freedom of movement and made photography in the field more convenient. Dawson's expedition journals are peppered with references to taking photographs. He chronicled his picture-taking in the same way as he recorded his other surveying activities; the phrases "got obsn. for lat ... wrote up notes ... examined rocks ... collected fossils ... changed plant-papers ... got a photo" — appear frequently, suggesting that photography was fully incorporated into his daily scientific work, even as he readily admitted that taking pictures occasioned delays in surveying operations and that photography could be an uncertain process.[22] Dawson documented the landscapes through which he travelled, and his photographs can be tied directly to his observations on drifts, sedimentary layering, and geological features described in his field notebooks.

The extensive photographic documentation produced by Hime, Baltzly, Horetzky, and Dawson — much of which survives in original negative or print form — circulated in official government reports and in popular narrative accounts; prints were sold to the public and published as engravings in the pictorial press. Ostensibly taken for scientific purposes, their survey photographs were also a visual record of landscapes key to colonial growth, settlement, and resource development. As such, they were called upon — in concert with reports, statistics, maps, and art — to support government decision-making and further nation-building efforts. Many were employed as much as tools of political persuasion and territorial appropriation as of geographical description and scientific exploration.[23]

Engineering and Technology

Photographs communicated to viewers that British North America was a place where feats of engineering and marvels of technology were required to overcome the physical challenges posed by Nature. Photographs of public works projects were assembled to buttress government arguments about territorial expansion, encourage settlement, promote travel, and inventory points of interest. Especially popular with commercial photographers and public alike were subjects associated with the coming of the railways:

Figure 3. *[William England], No. 145— Niagara Suspension Bridge, U.S. from the London Photographic and Stereoscopic Company series "America in the Stereoscope," albumen prints on stereoscopic card mount, recto and verso, 1859. Author's collection.*

views of railbeds, stations, bridges, embankments, and other sites that offered visual evidence of mastery over Nature through technological ingenuity. Of all British North American engineering works, two in particular were heralded as marvels, worthy of widespread attention.

The Niagara Suspension Bridge, designed by John Roebling (who later designed the Brooklyn Bridge), defied the critics who said a suspension bridge could not withstand the stresses of a moving train. First crossed by a passenger train in March 1855, the bridge was photographed in 1859 in both single and stereoscopic format by William England, chief photographer for the London Photographic and Stereoscopic Company as part of the company's first series of New World views (**Fig. 3**). It was also photographed by William Notman for the "Maple Box" series of views presented to Queen Victoria as a gift on the occasion of the visit of the Prince of Wales to open the Victoria Bridge.

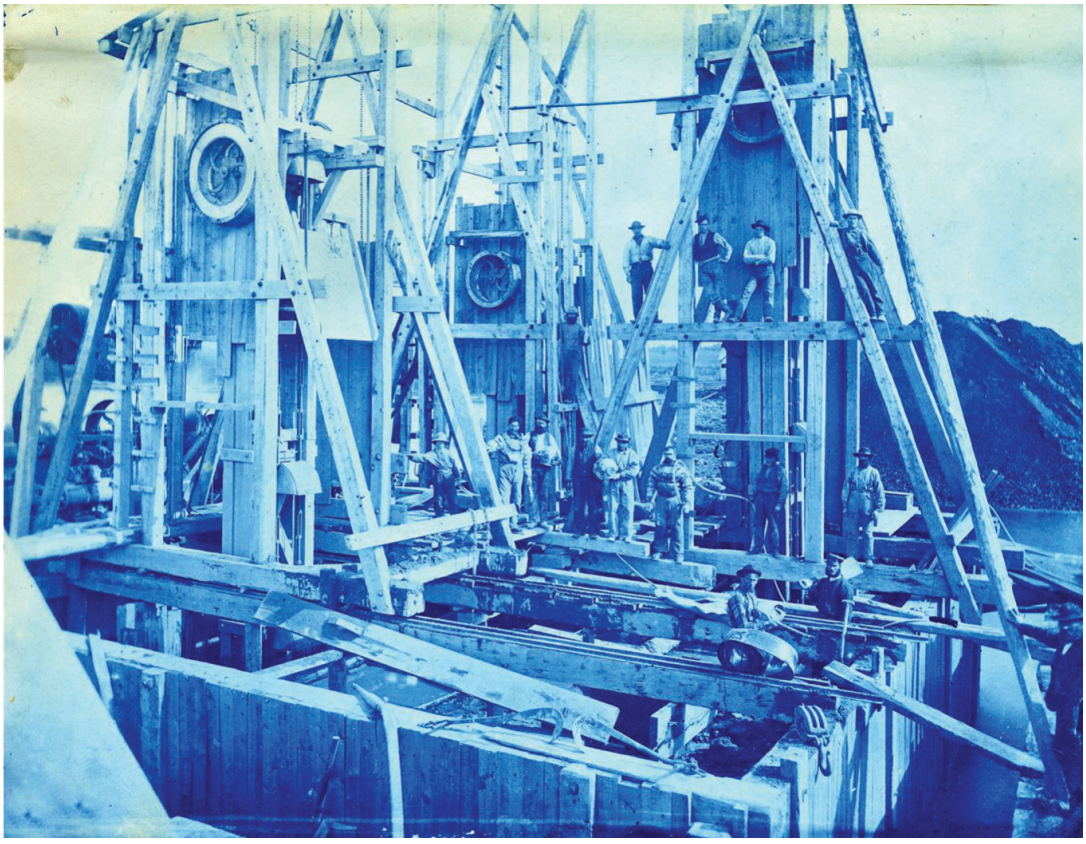


Figure 4. *William J. Williams, crew with diving equipment, from a series of views of the construction of the Miramichi Bridges on the Intercolonial Railway, ca. 1873. cyanotype, 20.25x15.65cm. Provincial Archives of New Brunswick, Frank Sayer collection, P119-2-97.*

Described as "perhaps the most extraordinary of all the great works of engineering genius which have been constructed in this age,"[24] the Victoria Bridge carried the Grand Trunk Railway across the St. Lawrence and gave Canada the economic advantage of access to an ice-free port in winter. Construction and completion of the bridge were photographed by several Montreal photographers, none more extensively than William Notman, whose documentation remains the definitive record. His construction-progress images, also included in the "Maple Box," circulated as part of an extensive, commercially available series of stereoscopic views, and served as the basis of lithographs in James Hodges' *Construction of the Great Victoria Bridge in Canada*, published in London in 1860.[25] Notman's photographs gave visual expression to the parade of statistics regularly presented as evidence of the prodigious accomplishment that the bridge represented.[26]

Lesser known engineering works were also photographed. In New Brunswick, for example, the construction of the Miramichi Bridges on the Intercolonial Railway was carefully documented in a series of photographs of piers, pilings, abutments, caissons, gantry staging, dredging machinery, and general site views. A set of card-mounted prints with letterpress text in Library and Archives Canada has long been assumed to be the work of ICR photographer Alexander Henderson; however, a handwritten note in an album of cyanotype prints (**Fig. 4**), compiled by a Moncton railway engineer, attributes

them to William J. Williams, described by the *Miramichi Advance* as one of the best landscape photographers in the province. In the collection of the New Brunswick Museum, a card-mounted print from his series of photographs of a log jam at the Southwest Miramichi railway bridge carries the credit line "W. J. Williams, Photographer to His Grace the Duke of Beaufort. River Du Loup, P.Q., and Campbellton, N.B."[27]

A series of views of "ponts et ponceaux" by Jules-Ernest Livernois, along with photographs by Alexander Henderson, were used to produce the album *Photographs of Wrought Iron Railroad Bridges Constructed and Erected for the Government of the Dominion of Canada on the Line of the Quebec, Montreal, Ottawa & Occidental Railway.* This album becomes a telling scientific argument in its own right when viewed in the context of a disagreement between Sandford Fleming, Chief Engineer of the Intercolonial Railway, who favoured use of masonry piers and wrought iron superstructures, and the Commissioners of the Intercolonial, who insisted bridges be built of wood. Speculation over the instability of wooden railway bridges, can be traced to the evening of 12 March 1857, when the westbound train out of Toronto plunged through the timber swing bridge over the Desjardins Canal, just outside Hamilton, killing 59 people. In the wake of the accident, Hamilton photographer Robert Milne was hired by the Assistant Engineer of the Department of Public Works to photograph "some of the broken portions of the structure." Milne's photographs "of every important fracture in the timber of the bridge" were examined in the course of the inquest and incorporated into the official report into the causes of the disaster.[28]

Other Scientific Pursuits

Throughout the middle decades of the nineteenth century, photography proved ill-suited for some scientific purposes. Camera equipment was heavy and bulky, and the wet-collodion process was refractory and labour-intensive. Early emulsions were slow and unable to record moving subjects. Existing processes were only capable of producing monochromatic images in shades of brown and cream, and, even then, emulsions were not uniformly sensitive to the whole spectrum; photography in full colour was still a long way off. Whereas some of the earliest applications of the medium in British North America were in the study of botany, photography was ultimately of limited value to botanical study. Live plants could not remain motionless for the duration of a several-second exposure and colour was critical to identification. More importantly, a photograph captured a specific specimen, whereas botanical drawings conventionally presented an idealized plant showing all its parts and in all stages—from root ball to flower, seed, stamen, and petal structure. Despite such limitations, in 1866, l'Abbé Louis-Ovide Brunet, the eminent botanist and professor at l'Université Laval, engaged Livernois et Cie to produce "un herbier photographique" of 34 photographs of trees, ferns, and plants; his series of photographs of the flora of Quebec, entitled *Sites et végétaux du Canada*, was exhibited at the 1867 Exposition universelle in Paris.[29]

Perhaps nowhere was the inability of photography to stop motion more problematical than in ornithology. Nevertheless, in 1876, Henry Vennor published *Our Birds of Prey: Or, The Eagles, Hawks, and Owls of Canada*, "with 30 photographic illustrations by William Notman" (**Fig. 5**). Aimed at the public, it was intended to be "an aid to our young collectors in the identification of their specimens" as well as to awaken "a more lively interest"

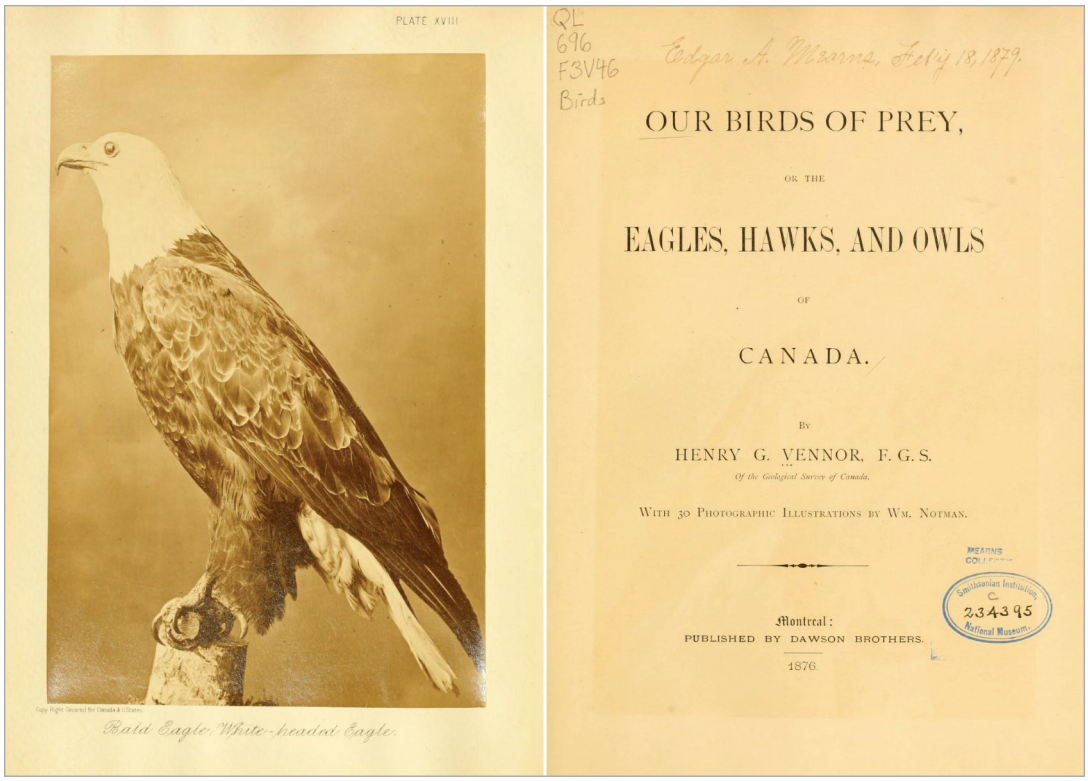


Figure 5. *Frontispiece and title page,* ***Our Birds of Prey, or the Eagles, Hawks, and Owls of Canada*** *by Henry G. Vennor, F.G.S., with 30 Photographic Illustrations by Wm Notman. Montreal: Dawson Brothers, 1876.*

in ornithology generally.[30] Likely the first book of its kind in North America,[31] *Our Birds of Prey* presents a rare instance where photographs, specimens, and text were intended to work in concert. It was technologically innovative on two counts: to confront the failure of slow emulsions to stop motion, Vennor used taxidermied specimens posed against blank backgrounds; and to overcome the inability of prevailing printing technology to reproduce photographs on the same page as letterpress text, he matched text with original albumen prints, hand tipped onto pre-printed pages.

In his Introduction, Vennor highlighted the centrality of images to his book: "As a work of this kind unillustrated would be but of little service to our students or the public generally, I have, after much consideration and no little experimenting, accomplished this by photography."[32] To that end, he engaged William Notman, who "entered heart and soul into the undertaking" and "spared neither material nor labor, in order to render the Plates satisfactory and truthful to nature." Vennor suggested Notman's reputation was "sufficient guarantee" of the photographs' merit and acknowledged that "any defect" in the volume was to be attributed to his selection of the specimens:

> I have not chosen, in any case, rare, unusual, or particularly beautiful plumaged individuals to represent the different species, but rather common or typical forms of these, male and female, young and adult, or such as the collector and traveller would most generally meet.[33]

Vennor emphasized that the "main object of this work" was "practical utility—not a mere exhibition of pretty photographs."[34] Anticipating criticism regarding the "Attitude and Form of the Birds figured," he admitted that "a great deal of attention [was

required] in the photographing of stuffed specimens," and declared, "no Plates no matter how perfectly executed, could please all." Grounding his authority in more than a decade of field work with the Geological Survey of Canada, Vennor touched upon a contentious point in the ornithological community:

> I have invariably found that those who find most fault in this respect, are persons who have been little in the field themselves, or, in other words, who rather belong to the class known as *closet*, than *field* naturalists; the latter knowing well that it is really almost impossible to conceive of a position which is not sometimes assumed by the living bird.[35]

With this, Vennor effectively dismissed his critics in advance of reviews of the book.[36]

Photography was also employed to a greater or lesser extent across a range of other scientific investigations. For example, in the field of medical illustration and anatomical study, the February 1869 issue of the *Dominion Medical Journal* illustrated "A Case of Partial Placenta Praevia, Accompanied with Foetal Exomphalus" by J.F. Dewar, M.D., with an original photograph. The foetus—"decidedly an anomaly"—was hardly recognizable. So ill-shapen was the mass of child, organs, tumour, and placenta that Dewar felt compelled to inform readers, "The accompanying plate is a photograph of the foetus," and lamented that "owing to various circumstances I was only enabled to take a photograph, hence must be attributed the vagueness of the description." Nevertheless, the photograph, however vague, was judged to warrant the cost and effort of inserting an original albumen print into each copy of the journal on the grounds that the case was of broad medical interest. Here, Dewar's photograph of the anomalous foetus offered stark evidence of its existence rather than useful details of its morphology.[37]

Appealing to prevailing ethnographic interest in the primitive or exotic peoples of the world, Frederick Dally's commercially produced *carte-de-visite* likenesses of Indigenous individuals of the island and mainland of British Columbia sold in large numbers. Purchased by white settler-colonists as souvenirs, they were pasted into albums, inserted into diaries, and enclosed with correspondence. Incorporated into the work of Joseph Barnard Davis, Thomas Henry Huxley, Carl and Frederick Dammann, and Felix von Luschan, they entered international networks of science in projects to measure cranial capacity, identify "native types," and study the "races of man". This dissemination and repurposing of Dally's *carte* likenesses demonstrate how photographs followed fluid biographical trajectories between popular and scientific spheres.[38]

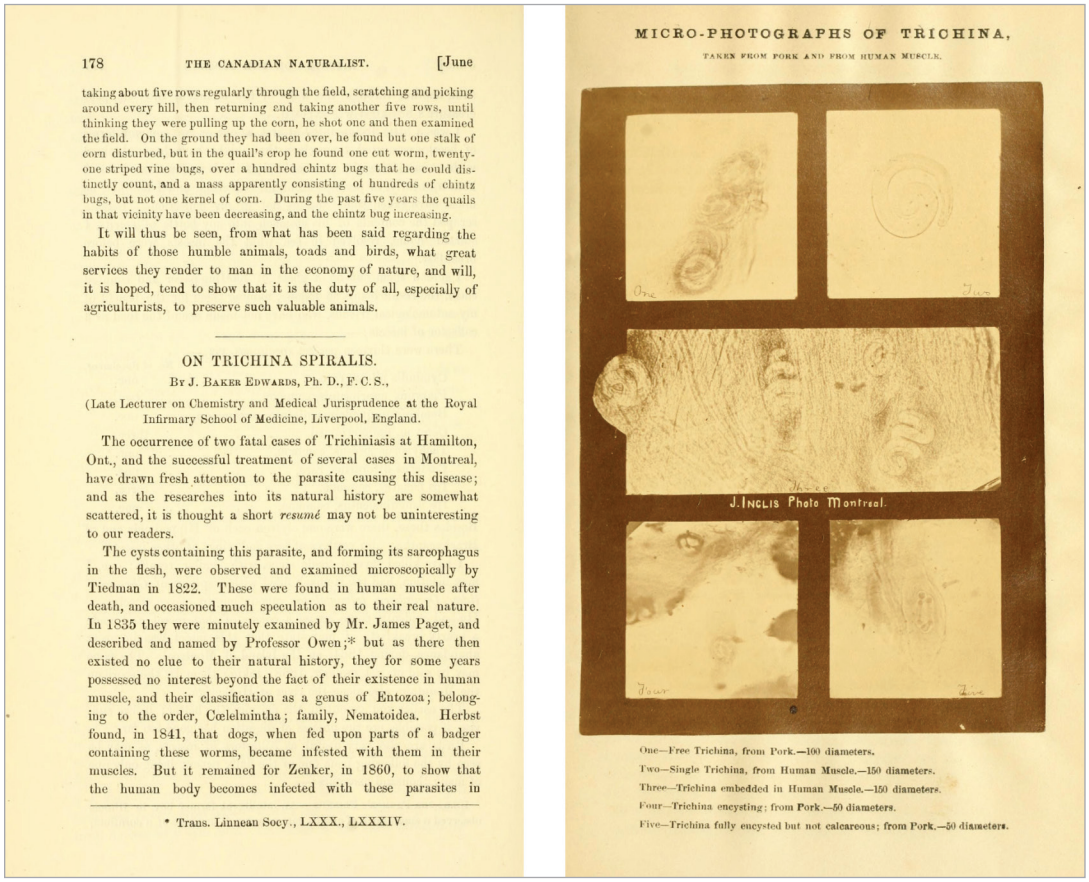
Systematic study of glaciers in the Canadian Rockies began with photographic documentation by Mary Vaux and her brothers George and William of Philadelphia. The three first travelled west as tourists, arriving by train from Montreal at the newly opened Glacier House in 1887. The hotel, adjacent to the line of the CPR between Rogers Pass and The Loops, had been built to eliminate the need for dining cars on passenger trains through the mountains. Located just below the Great Glacier, it became a prominent tourist destination, and the Vaux siblings returned in 1894. Comparison of their photographs taken on the two visits clearly revealed the recession of the glacier's terminus, and spawned Mary Vaux's repeated photographic documentation of the glacier and its retreat at fixed points over the period 1887 to 1912.[39] Her work formed the basis for subsequent measurements and analysis of the glacier's upslope retreat and has been used as a baseline for modern studies in glaciology and climate change, including the Mountain Legacy Project based at the University of Victoria.[40]

Circulation of Scientific Knowledge

Knowledge of the science and technology of photography itself circulated through newspapers, the periodical press, and informal networks of photographers.[41] Experimentation in photo-chemistry was a topic of discussion at meetings of the Canadian Institute and the Natural History Society, and among leading photographers of the day. Among the papers of painter and photographer William Sawyer, we find recipes for photographic emulsions jotted down in pencil on scraps of paper and the back of invitations to meetings of the Kingston YMCA and even on a broadsheet for The Army & Navy Clothing Store, Toronto. Sawyer's notes — some copied from *The Photographic News*, others credited to Notman, James Inglis, Henry K. Sheldon, and Quebec-born American lithographer and photographer Napoleon Sarony — show how the chemical formulae for emulsions, developers, fixers, and toners circulated and were shared within the photographic community. Sawyer's annotations — "for landscapes"; "for portraits in summer"; "good for positives in preserving clear shadows"; "alcohol not recommended" — suggest recipes were collected, exchanged, tested, and compared.[42] How then, we might ask, was the science of photography investigated by practitioners at the local level, and how were their findings and cumulative knowledge mobilized more widely?

Beginning in the late 1850s in British North America, portfolios, books, and journals began to appear with original photographs as illustrations. The use of albumen prints pasted onto blank or pre-printed pages was a costly and labour-intensive but effective means of overcoming the limitations of existing printing technology to reproduce continuous-tone photographic images on the same page as letterpress text. [43] Studio portraits of prominent civic figures anchored Notman's three-volume serial publication *Portraits of British Americans*, which matched *carte-de-visite*-sized likenesses with the biographies of 84 leading men of the day, including science personalities William Dawson and William Logan.[44] Logan's likeness, which appears in the 1865 volume, stands out from the majority of portraits taken in Notman's studio; it shows him seated against cabinets of geological specimens, surrounded by his collection of rocks and fossils, a copy of *The Geology of Canada* on the table beside him, and the tools of his trade at his feet.[45] Taking their place among statesmen, clergymen, military men, and others in positions of "responsibility and honor in the political and social history of the British American Provinces,"[46] Dawson and Logan became public figures recognized for their contributions to science and its importance in the march towards Canadian nationhood.

In early 1864, Rev. W. Hincks, Fellow of the Linnean Society and Professor of Natural History at the University of Toronto, read a paper entitled "On *Cygnus Passmori*, a supposed new American Swan" before the Linnean Society in London. Subsequently published in the Society's journal, it was illustrated by a drawing of the head and neck "taken from a photograph by Mr. Octavius Thompson, of Toronto, from the only specimen yet obtained of *Cygnus Passmori*."[47] Thompson's photograph has yet to surface, but the reference to it as the basis of an illustration in a scientific journal — like mention of the use of photography at the Royal Magnetic and Meteorological Observatory — points to an expanded conception of photographic research based not solely on surviving images.



178 THE CANADIAN NATURALIST. [June

taking about five rows regularly through the field, scratching and picking around every hill, then returning and taking another five rows, until thinking they were pulling up the corn, he shot one and then examined the field. On the ground they had been over, he found but one stalk of corn disturbed, but in the quail's crop he found one cut worm, twenty-one striped vine bugs, over a hundred chintz bugs that he could distinctly count, and a mass apparently consisting of hundreds of chintz bugs, but not one kernel of corn. During the past five years the quails in that vicinity have been decreasing, and the chintz bug increasing.

It will thus be seen, from what has been said regarding the habits of those humble animals, toads and birds, what great services they render to man in the economy of nature, and will, it is hoped, tend to show that it is the duty of all, especially of agriculturists, to preserve such valuable animals.

ON TRICHINA SPIRALIS.

By J. Baker Edwards, Ph. D., F. C. S.,

(Late Lecturer on Chemistry and Medical Jurisprudence at the Royal Infirmary School of Medicine, Liverpool, England.

The occurrence of two fatal cases of Trichiniasis at Hamilton, Ont., and the successful treatment of several cases in Montreal, have drawn fresh attention to the parasite causing this disease; and as the researches into its natural history are somewhat scattered, it is thought a short *resumé* may not be uninteresting to our readers.

The cysts containing this parasite, and forming its sarcophagus in the flesh, were observed and examined microscopically by Tiedman in 1822. These were found in human muscle after death, and occasioned much speculation as to their real nature. In 1835 they were minutely examined by Mr. James Paget, and described and named by Professor Owen;* but as there then existed no clue to their natural history, they for some years possessed no interest beyond the fact of their existence in human muscle, and their classification as a genus of Entozoa; belonging to the order, Cœlelmintha; family, Nematoidea. Herbst found, in 1841, that dogs, when fed upon parts of a badger containing these worms, became infested with them in their muscles. But it remained for Zenker, in 1860, to show that the human body becomes infected with these parasites in

* Trans. Linnean Socy., LXXX., LXXXIV.

MICRO-PHOTOGRAPHS OF TRICHINA,

TAKEN FROM PORK AND FROM HUMAN MUSCLE.

J. Inglis Photo Montreal.

One—Free Trichina, from Pork.—100 diameters.
Two—Single Trichina, from Human Muscle.—150 diameters.
Three—Trichina embedded in Human Muscle.—150 diameters.
Four—Trichina encysting; from Pork.—50 diameters.
Five—Trichina fully encysted but not calcareous; from Pork.—50 diameters.

Figure 6. *James Inglis, "Micro-Photographs of Trichina, taken from pork and from human muscle," to accompany J. Baker Edwards, "On Trichina Spiralis."* ***The Canadian Naturalist and Quarterly Journal of Science*** *4, no. 2 (June 1869): 178-183. https://www.biodiversitylibrary.org/item/33092*

In 1869, two articles in *The Canadian Naturalist and Quarterly Journal of Science* were illustrated with original photographs. Three months before Smallwood's article on the partial eclipse appeared, J. Baker Edwards published "On Trichina Spiralis" with a page of "Micro-Photographs of Trichina, taken from pork and from human muscle."[48] These were made from "some excellent negatives" by Mr. C. Baillie who "placed his micro-photographic apparatus" at Edwards' disposal. The five micro-photographs, each numbered and labelled individually with the magnification (from 50 to 150 diameters) specified, were then printed as a single photograph by Montreal photographer James Inglis (**Fig. 6**). Edwards' use of micro-photographic technology and his detailed text which referred directly to the photographs — two from fatal cases of Trichiniasis at Hamilton and three from successfully treated cases in Montreal — is another example of the explicit use of photographs in the scientific literature in Canada in the nineteenth century.

Towards New Scholarly Agendas

In the introduction to her now-classic text *Photography at the Dock*, Abigail Solomon-Godeau described photography as "a medium whose very ubiquity may well have fostered its invisibility as an object of study."[49] It is, therefore, not surprising that, in their textbook *History of Science in Society: From Philosophy to Utility*, Andrew Ede and Leslie Cormack devote only a single paragraph to photography, noting almost obliquely that "Röntgen's work and the medical application of X-rays would not have been possible without the invention of photography." With a nod to Nicéphore Niépce, Louis Jacques Mandé Daguerre, and George Eastman, they telescope fifty years of the history of photography into three sentences. In such a massive survey of science, from the early Greek philosophers to "new frontiers" of the 21st-century, one can hardly expect much space to be devoted to photography. However, their conclusion—that photography is "perhaps the best example of a commercial invention that was then brought into the laboratory, where it became a tool for everything from astronomy to cell biology"[50]—does not do justice to either the origins of photography at the intersection of optics and chemistry, or to its applications, utility, and impact as a technology within scientific inquiry across a range of disciplines.

A spate of recent exhibitions and publications have focused on "photography and science"[51] yet it remains to explore more fully the role played by photography in the production and mobilization of scientific knowledge in Canada. This overview of photography in nineteenth-century science and technology in British North America points to some of the ways in which photographic images, practices, and experimentation reflected, inspired, underpinned, and enabled scientific study and technological advance. It highlights some of the opportunities and challenges of photo-historical research and offers directions for "further looking." It argues that photography played an integral part in the scientific encounter with British North America and suggests that there is a rich vein of visual research to be mined by historians of science and technology in the Canadian context. It also offers several caveats for investigating both photographs as visual images and photography as a social practice within the history of science and technology.

Photographic history has traditionally been written from surviving images. The role of photography in society has long been written from surviving images and from an art historical or curatorial perspective. The subject, however, is far larger and more interesting if we drill down into the documentary record to locate accounts detailing the application of the new technology to quotidian activities and professional pursuits in newspapers, journals, and, especially, the writings of early practitioners, promoters, and critics of photography, who speculated enthusiastically—often remarkably presciently—about the utility of camera-made images for scientific study. Of course, expectations were not always met; anticipated applications were not always realized; and photographs have not always survived. Photographic images produced for the purpose of extracting quantifiable information were never expected to outlive their usefulness in the process of data gathering, measurement, and analysis. Still, as with the examples given in

astronomy and ornithology, much can be learned from references in the written and printed record to the role of photography in the production and circulation of knowledge in science and technology, whether or not the images still exist to be examined.

Photographs employed in the pursuit of science are not always overtly scientific. Even when photographs have survived, the visual information presented in them does not always appear rigorously scientific to us now. Photographs taken for one purpose could be used for another. Even at the time of their creation and circulation, when many observers would not have been familiar with photographs for scientific study, some images needed explanation and justification. Smallwood felt compelled to explain the "light part" and the "dark projections" in Notman's photographs of the 1869 eclipse. Vennor felt obliged to justify his use of taxidermied specimens. Equally, photographs which needed no explanation or justification then may require contextual understanding now because their scientific nature may only become evident when considered in terms of their provenance, functional origins, and social biography.

Photographs do not reveal their secrets easily. In order to comprehend photographs as "working objects in their own time," we need to look *at* them as both images and objects; to look *through* them for the facts they both include and exclude; and to look *with* them to explore and understand the larger contexts in which they were invested with and generated meaning. As with Dally's ethnographic *carte* likenesses, the "science" communicated by a photograph is not always evident from surface appearance alone; it may only accrue over time or may only emerge when its visual content is placed in the physical, intellectual, or social context of its creation, circulation, viewing, use, or preservation. Knowledge of history (time and place) and prevailing photographic science (processes) and technology (equipment) is required to understand both what was prescribed and proscribed as appropriate subject matter in contemporary terms and what could and couldn't be photographed in practical terms. Opportunities to do so await historians of science and technology, whose scholarly perspectives may pry open new ways of seeing and thinking about photographs and draw new conclusions from them as primary sources. Such disciplinary perspectives are needed to complement and supplement the study of visual images within Art History, which in recent years has expanded its disciplinary purview to canonize photographs from domestic albums, government surveys, and scientific research.

Suzanne Zeller argues for the role of inventory science in the formation of Canada as a transcontinental nation. In particular, her observation that "the heritage of Enlightenment thought emphasized the importance of collecting, cataloguing, and disseminating scientific information as widely and rationally as possible" links directly to Solomon-Godeau's examination of the mid-nineteenth-century passion for documentation ("taxonomies, inventories, and physiologies"), and her assessment of photography as a tool of positivist thinking ("the agent par excellence for listing, knowing, and possessing, as it were, the things of the world").[52]

Ultimately, this essay proposes that the role of photography in the history of science and technology in Canada warrants investigation and that photographs be incorporated more fully as primary sources in the scholarly agendas of historians of science and technology. What, we need to ask, might photographs reveal about the state of science and expectations for technology, if we return them to the intellectual and physical contexts in which they were made, circulated, viewed, and understood? How did photographic practices contribute to the pursuit of science and technology, and how did scientific and technological pursuits contribute to the practice of photography? Here, we might note, an invention by a Canadian scientist changed the face of photography.

In 2009, Canadian physicist Willard Boyle was awarded the Nobel Prize in Physics for his role in the invention of the charge-coupled device, the basis of now ubiquitous digital imaging and surveillance technology.[53] This, of course, raises the interesting question whether electronic imaging represents a logical extension or a distinct rupture in the evolution of photographic technology. The answer—if indeed there is one—lies not in the similarities or differences in the visual appearance of the end-products of their respective optical-chemical and digital applications, but rather in a comparison of the perceived uses, circulation, meanings, and truth-value of analogue, scanned, and born-digital images in social and scientific practice. This essay offers a baseline from which to undertake such a comparison.

Joan M. Schwartz is Professor Emerita, History of Photography and Nineteenth-Century Visual Culture, and former Head, Art History and Art Conservation, Queen's University. Before taking up her faculty position in 2003, she was Senior Specialist in Photography Acquisition and Research at the National Archives of Canada, where she had worked as an archivist since 1977. A historical geographer, and photographic historian, with a particular interest in photography and the geographical imagination, she is a fellow of the Royal Society of Canada and the Royal Canadian Geographical Society, as well as the Society of American Archivists and the Association of Canadian Archivists.

Acknowledgements: *Research for this essay was carried out with support from Queen's University, an Insight Grant from the Social Sciences and Humanities Research Council of Canada, and a Leverhulme Visiting Professorship at the Centre for the GeoHumanities, Royal Holloway, University of London. I am also grateful to generous friends and colleagues Andrew Birrell, Andrew Rodger, Theresa Rowat, Hélène Samson, Tim Fedak, Josh Green, Peter Larocque, Daniel Lewis, Kirsten Greer, Brendan Cull, Brendan Edwards, Alison Morrison-Low, Elizabeth Edwards, Kelley Wilder, and Mirjam Brusius for sharing their research and expertise with me.*

Endnotes

1 *The Colonial Pearl,* 10 May 1839, 150.

2 *The Colonial Pearl*, 31 May 1839, 174.

3 *The Colonial Pearl*, 7 June 1839, 182.

4 While the daguerreotype and calotype were very different in physical support, practical application, and visual aesthetic, I use "photography" here as an umbrella term to refer broadly to those newly circulating processes for making permanent an image directly from nature by optical-chemical means.

5 In his diary, Daniel Wilson noted that his colleague Rev G.C. Irvine, professor of mathematics at Trinity College (Toronto) "is a Cambridge man, and an amateur calotypist, so we were friends at once in spite of our rival colleges." Letter, 25 November 1853. Sir Daniel Wilson's Journal. Typescript, p.14. Copied and edited by H.H. Langton. University of Toronto Archives, File B1965-0014/003(01), available online at: https://discoverarchives.library.utoronto.ca/index.php/sir-daniel-wilsons-journal-typescript-copied-and-edited-by-h-h-langton-containing-entries-relating-to-university-of-toronto-portions-concerning-domestic-troubles-of-sir-daniels-daughter-jessie-have-be [accessed 3 August 2022]. I am grateful to friend and mentor Andy Birrell, for drawing my attention to this reference. See Andrew J. Birrell, "The Early Years, 1839-1885," in Lilly Koltun, ed., *Private Realms of Light: Amateur Photography in Canada, 1839-1940* (Toronto: Fitzhenry & Whiteside, 1984), 5.

6 This argument builds on Suzanne Zeller's now classic study *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation* (Toronto: University of Toronto Press, 1987).

7 *Rowsell's City of Toronto and County of York Directory for 1850-1* (Toronto: Henry Rowsell, 1850), lxxxi. Available online at: https://static.torontopubliclibrary.ca/da/pdfs/1643688.pdf

8 Charles Smallwood, "On the Partial Eclipse of the Sun, August 7th. 1869," *The Canadian Naturalist and Quarterly Journal of Science* 4, no. 3 (1869): 249-256; quote 251; original albumen print hand-tipped onto an unnumbered page, facing 249.

9 Smallwood, "On the Partial Eclipse," 250, 256.

10 Stanley G. Triggs, *William Notman: The Stamp of a Studio* (Toronto: Art Gallery of Ontario / The Coach House Press, 1985), 26.

11 Thomas Evans Blackwell, *Reminiscences of North America* I [Blackwell Album]. Library and Archives Canada, Item ID number:139644. http://central.bac-lac.gc.ca/.redirect?app=fonandcol&id=139644&lang=eng

12 Charles Lyell, *Travels in North America in the Years 1841-2; with Geological Observations on The United States, Canada, and Nova Scotia*, Vol. 1. (New York: Wiley and Putnam, 1845), 77.

13 Charles F. O'Brien, "*Eozoön Canadense*: 'The Dawn Animal of Canada,'" *Isis* 61, 2 (1970): 206.

14 Nature printing is a print-making technique developed long before the invention of photography but similiar in principle to Talbot's photograms of leaves and lace placed directly on sensitized photographic paper. It produces a direct impression of an object by pressing a plant or fossil directly into a soft lead printing plate, which can then be used to produce a perfect impression of the object in small numbers. For larger print-runs, the electrotyping process is employed to produce a sturdier copper plate. See Roderick Cave, *Impressions of Nature: A History of Nature Printing* (London: British Library /Mark Batty, 2010). J.W. Dawson, "On Certain Organic Remains in the Laurentian Limestones of Canada," *The Canadian Naturalist and Geologist*. New Series, April 1865,.99-111, figure on 101. Dawson explained that "a wax mould of the etched surface [of the specimen] furnished the electroype cast" from which the figure was printed. Online: https://babel.hathitrust.org/cgi/pt?id=inu.32000004347052&view=1up&seq=111 [accessed 28 November 2022].

15 Dawson's paper, read to the Geological Society (London) on 12 May 1875, was published as "Notes on the Occurrence of *Eozoon Canadense* at Côte St Pierre" in the *Quarterly Journal of the Geological Society of London* 32 (1876): 66-75; quote 66. Weston's photographs have been located in the Nova Scotia Museum; later prints by Alexander Henderson in the McGill Archives and the McCord Museum are mounted on card to show "some unique fossil specimens of McGill University, 1874-76". I am grateful to Tim Fedak Curator of Geology, Nova Scotia Museum; Theresa Rowat, former Director, McGill University Archives; and Hélène Samson Curator Emerita of Photography, McCord Museum, for bringing to my attention T.C. Weston's prints in their collections.

16 J.W. Dawson, *The Dawn of Life; being the History of the Oldest Known Fossil Remains, and their relation to Geological Time and to the Development of the Animal Kingdom* (Montreal: Dawson and London: Hodder & Stoughton, 1875).

17 Richard Daintree and C.S. Wilkinson, "Portions of the parishes of Puebla, Paraparap, Duneed and Jan Juc," Quarter sheet 28 SE. 1:31 680 geological map. Geological Survey of Victoria, 1863. On the map, a small square with a dot inside it indicates "Station from which Photographic View taken by R. Daintree, Field Geologist" and along the right hand edge of the sheet is a coastal view "Lithographed ... from a photograph by R. Daintree." Available online: http://earthresources.efirst.com.au/product.asp?pID=464&cID=24 [accessed 28 November 2022].

18 A.R.C. Selwyn, "Journal and Report of Preliminary Explorations in British Columbia," in *Geological Survey of Canada, Report of Progress for 1871-72* (Montreal: Dawson Brothers, 1872), 17.

19 Andrew Birrell, "Survey Photography in British Columbia, 1858-1900," *BC Studies* 52 (Winter 1981-82): 39-60, quote on 49.

20 Morris Zaslow, *Reading the Rocks: The Story of the Geological Survey of Canada, 1842-1972* (Toronto: Macmillan Company of Canada, 1975), 109.

21 See Richard J. Huyda, *Camera in the Interior, 1858: H.L.Hime, The Assiniboine and Saskatchewan Exploring Expedition* (Toronto: The Coach House Press, 1975); Andrew J. Birrell, *Benjamin Baltziy: Photographs and Journal of an Expedition through British Columbia, 1871* (Toronto: The Coach House Press, 1978); Andrew Birrell, "Fortunes of a misfit: Charles Horetzky," *Alberta Historical Review* 19, no. 1 (Winter 1971): 9-25.

22 See George Mercer Dawson, *The Journals of George M. Dawson*. eds. Douglas Cole and Bradley Lockner (Vancouver: The University of British Columbia Press, 1989).

23 As I have discussed elsewhere, Hime's photographs *The Prairie, on the banks of Red River, looking south* and *The Prairie, looking west* had important political ramifications for Montreal- and Toronto-based investors looking west with a view to Canadian territorial expansion, and for British interests looking south to meet the menacing gaze of American Manifest Destiny. See Joan M. Schwartz, "More than 'competent description of an intractably empty landscape': a strategy for critical engagement with historical photographs," *Historical Geography* 31 (2003): 105-130. For a discussion of photography as a device of Indigenous erasure in settler colonial contexts, especially in relation to exploration, surveying, and land occupation, see Jarrod Hore, *Visions of Nature: How Landscape Photography Shaped Settler Colonialism* (Oakland: University of California Press, 2022).

24 "Construction of the Victoria Bridge at Montreal in Canada," *The Edinburgh Review* 108, no. 229 (1861): 74-86.

25 James Hodges, *Construction of the Great Victoria Bridge in Canada* (London: John Weale, 1860).

26 In addition to the usual dimensions—length, width, height off the water, number of piers—the public was treated to a barrage of statistics: 9,044 tons of iron, 1,540,000 rivets, 32 acres of paint, 2,713,095 cubic feet of masonry, 2,280,000 cubic feet of timber. "Construction of the Victoria Bridge," 86.

27 I am grateful to Josh Green, Manager, Media Unit, Provincial Archives of New Brunswick, Fredericton, and Peter Larocque, Head, Humanities Department and Art Curator, New Brunswick Museum, Saint John, for generously sharing their research on Williams with me.

28 Joan M. Schwartz, "Documenting Disaster: Photography at the Desjardins Canal, 1857," *Archivaria* 25 (Winter 1987-88): 147-154.

29 While Livernois's photographs bear a striking resemblance to photogenic drawings of ferns by William Henry Fox Talbot and cyanotypes of British ferns and algae by Anna Atkins, they were not photograms, made by placing specimens directly on light sensitive paper, but rather albumen prints from wet collodion negatives made with a camera. See Brendan Cull, "Early Canadian Botanical Photography at the Exposition universelle, Paris, 1867," *Scientia Canadensis* 39, no. 1 (2016-17): 27–50.

30 Henry G. Vennor, *Our Birds of Prey: Or, The Eagles, Hawks, and Owls of Canada. With 30 photographic illustrations by Wm. Notman* (Montreal: Dawson Brothers, 1876).

31 Vennor's book bears a superficial resemblance to *The Birds of Berkshire and Buckinghamshire: a contribution to the natural history of the two counties by Alexander W. M. Clark Kennedy* (Eton, London [printed], 1868), which contains four hand-coloured photographs of taxidermied birds set in dioramas.

32 Vennor, *Our Birds of Prey*, vi.

33 Vennor, *Our Birds of Prey*, vi.

34 Vennor, *Our Birds of Prey*, viii

35 Vennor, *Our Birds of Prey*, vi-vii. In his history of ornithological field guides, Thomas Dunlap notes: "Mounted, stuffed specimens gave some idea of living birds, but taxidermists paid little attention to the way different birds stood, and the patterns ... did not show up well in black and white, even when the photographer chose a good view." He also claims that "the greatest disadvantage of photographs [was that] any one photograph showed only one state of a bird's plumage in one light." Thomas R. Dunlap, *In the Field, Among the Feathered A History of Birders & Their Guides* (Oxford: Oxford University Press, 2011), 47, 184.

36 Reviews appeared in *Forest and Stream* 8, no. 19 (14 June 1877): 300; *The Zoologist*, 3rd series, 1, no. 2 (1877): 76-79; and *Nature* 15, no. 391 (1877): 546–547. I am grateful to Kirsten Greer for her many valuable insights into Vennor's contributions to nineteenth-century ornithological study; see Kirsten Greer, *Red Coats and Wild Birds: How Military Ornithologists and Migrant Birds Shaped Empire* (Chapel Hill: University of North Carolina Press, 2019).

37 J. F. Dewar, "A Case of Partial Placenta Praevia, Accompanied with Foetal Exomphalus," *Dominion Medical Journal* 1, no. 6 (February 1869): 103-4.

38 For a study of prevailing context of racial science and colonial power, see Elizabeth Edwards, "Professor Huxley's 'Well-considered Plan,'" in her *Raw Histories: Photographs, Anthropology and Museums* (Oxford and New York: Berg, 2001), 131-155, and her earlier work, "Photographic 'Types': The Pursuit of Method," *Visual Anthropology* 3, no. 2-3 (1990): 235-258. James R. Ryan draws upon these ideas in a chapter on "Photographing the Natives," in his *Picturing Empire: Photography and the Visualization of the British Empire* (London: Reaktion, 1997), 140-182.

39 For a comprehensive survey of the presence, practices, images, and impact of women photographers and studio workers in Canada, see Colleen Skidmore, *Rare Merit: Women in Photography in Canada, 1840–1940* (Vancouver: UBC Press, 2022). See also Diana Pederson and Martha Phemister, "Women and Photography in Ontario, 1839-1929: A Case Study of the Interaction of Gender and Technology," *Scientia Canadensis* 9, no. 1 (1985): 27-52.

40 The definitive work on the Vaux family photographs is still Edward Cavell's *Legacy in Ice: The Vaux Family and the Canadian Alps* (Banff: Altitude Publishing, 1983). The extensive Vaux Family fonds, held in the Whyte Museum of the Canadian Rockies, Banff, consists of glass and film negatives, prints, lantern slides, research papers, maps, and publications (Reference Code M107 / V653). Other photographs that have acquired scientific significance for glaciological study include scenic landscape views originally taken in the 1920s and 1930s for and circulated by the Canadian government's National Parks Branch as scenic landscapes to promote tourism in Banff, Jasper, and Glacier mountain parks. These now serve as visual evidence of climatological influences on the ablation or disappearance of formerly permanent high elevation snow patches and extensive ice fields. The Mountain Legacy Project can be accessed online at: https://mountainlegacy.ca/ [accessed 28 November 2022].

41 Tiit Kõdar, "The Canadian photographic periodical press," *History of Photography* 20, no. 2 (1996): 138-145.

42 William Sawyer fonds, Notes and Papers sub-series, Locator 2054, Box 4, file 3 [Formulae for Photography], Queen's University Archives, Kingston, ON.

43 In 1869, the circulation of scientific knowledge received a boost from the innovative "granulated screen process" patented by Quebec engraver and publisher William Augustus Leggo. See Kate Addleman-Frankel in this issue.

44 William Notman, *Portraits of British Americans,* 3 vol. (Montreal: William Notman, 1865, 1867, 1868). Dawson's biography is in Vol. 1, 1865; Logan's is in Vol.2, 1867.

45 William Notman, *William Edmond Logan*, 1865, albumen prints, 8.5 x 5.6 cm. McCord Stewart Museum, 16533 to 16539.

46 Notman, *Portraits of British Americans,* vol.1, 1865, ii.

47 Rev. W. Hincks, "On *Cygnus Passmori*, a supposed new American Swan," *Journal of the Proceedings of the Linnean Society of London: Zoology* 8 (1865): 1-8, drawing on 5. Online: https://archive.org/details/in.ernet.dli.2015.229792/page/n5/mode/2up?q=Hincks [accessed 28 November 2022].

48 J. Baker Edwards, "On Trichina Spiralis," *The Canadian Naturalist and Quarterly Journal of Science* 4, no. 2 (June 1869): 178-183, quotes 180.

49 Abigail Solomon-Godeau, *Photography at the Dock. Essays on Photographic History, Institutions, and Practices* (Minneapolis: University of Minnesota Press, 1994), xxi.

50 Andrew Ede and Leslie B. Cormack, *History of Science in Society: From Philosophy to Utility*, 3rd edition (Toronto: University of Toronto Press, 2017), 260.

51 See especially Kelley Wilder, *Photography and Science* (London: Reaktion, 2008); Ann Thomas ed., *Beauty of Another Order: Photography in Science* (New Haven, CT: Yale University Press / National Gallery of Canada, 1997).

52 Suzanne Zeller, *Land of promise, promised land: the culture of Victorian science in Canada* (Ottawa: Canadian Historical Association, 1996), 2; Solomon-Godeau, *Photography at the Dock*, 155.

53 Boyle shared the prize with his collaborator George E. Smith, and with British-American physicist Charles Kao, who discovered how light could be transmitted through fibre-optic cables.