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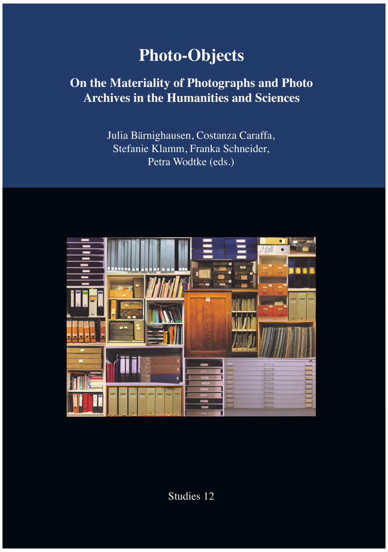
Lorraine Daston:

The Accidental Trace and the Science of the Future: Tales from the Nineteenth-Century Archives



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Chapter 4
The Accidental Trace and the Science of the Future: Tales from the Nineteenth-Century Archives

Lorraine Daston

Introduction: glass and paper forever

This glass photographic plate of a small square of the night sky, taken on a clear winter's night in Potsdam in 1894, is one of the around two million such astrophotographic plates stored in observatories all over the world (Lankford 1984, 29) (see Fig. 1). There are approximately 600,000 plates at the Harvard College Observatory, 20,000 at the Bologna University Observatory, 80,000 at the Odessa Astronomical Observatory, to give just a few examples (Hudec 1999). The designation of these collections as "archives" is mostly retrospective, but the glass plate pictured here was destined from the outset to be part of an archive: the vast astrophotographic survey of the sky as seen from the earth known as the Carte du Ciel. Launched at the Paris Observatory in 1887 and concluded (not completed) in 1974, the Carte du Ciel was intended as the legacy of nineteenth-century astronomy to the science of the future, in the form of approximately 22,000 such glass photographic plates: "the unimpeachable and imperishable state of the sidereal sky, which, in future centuries, will serve as the certain basis for the solution of the grand problem of the general constitution of the universe" (Flammarion 1887, 169). This fragile glass plate, one of the only 34 of the Potsdam Observatory's 1,200 Carte du Ciel plates to survive the bombings in World War II (Urban and Corbin 1998), was meant to endure "to the year 3000 at least"—that qualification added as a concession not to the impermanence of all things human but rather to doubts about "whether the chemical deposited on the glass will remain eternally unalterable."[1]

This paper squeeze of a Roman inscription in Spain (see Fig. 2) is one of the approximately 20,000 such squeezes (*Abklatsche*) held by the Corpus Inscriptionum Latinarum, another self-consciously archival project of the nineteenth century, this time in classical philology.

The technique of making paper squeezes of ancient inscriptions goes back at least to the sixteenth century, and the plan to publish all known Latin inscriptions in a single collection is almost as old (Larfeld 1907, 5–6, 39–53, 92–94). But the ambitions of the project proposed by the German legal historian and classicist Theodor Mommsen to the Prussian Academy of Sciences in 1847 (and officially begun in 1853) surpassed all of these earlier initiatives. The Berlin Corpus Inscriptionum Latinarum would not just collect previously published inscriptions. It would actively seek out as yet unpublished inscriptions from all over the territories that had once comprised the ancient Roman empire; it would weed out the

[1] Ernest Mouchez to David Gill, April 30, 1887, Bibliothèque de l'Observatoire de Paris, MS IV.A, "Comité international de la Carte du Ciel," carton 7.

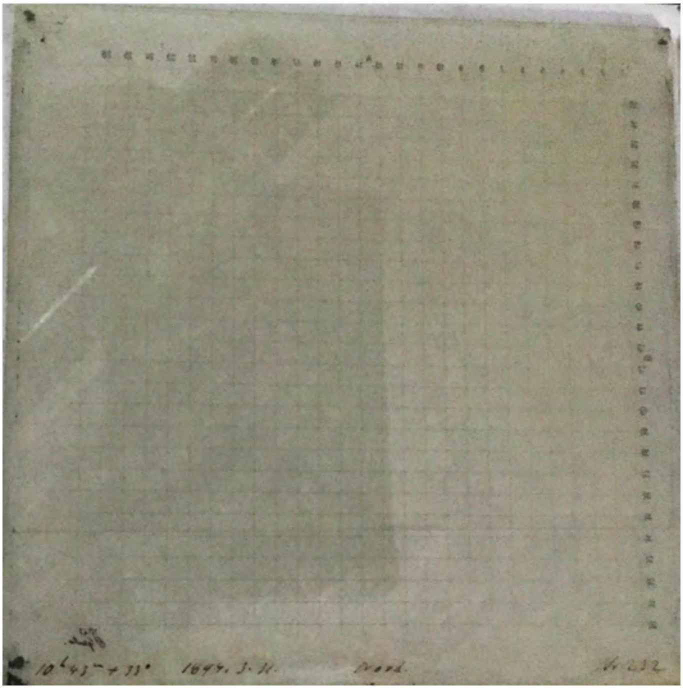

Fig. 1: Glass photographic plate from the Carte du Ciel survey, Potsdam Observatory, Plate 5, taken January 11, 1894. The plate is approximately 16 cm x 16 cm; each plate covered two square degrees of the sky, courtesy of the Leibniz-Institut für Astrophysik, Potsdam.

errors and forgeries in previously published collections of inscriptions. Wherever possible, its researchers would inspect the stones themselves—and make squeezes of the inscriptions.

The paper squeeze is the simplest of reproduction technologies, and it was precisely its simplicity that recommended it to philologists in the field, trekking to a remote North African village or clambering up a ladder to inspect an Italian bridge. The great advantage of the method was that it required little skill, could be used wherever paper and water were available, shipped easily, and produced a haptic negative of the original inscription, complete with every scratch and squiggle (Hübner 1881, 5–6). The squeeze could "not only replace the study of the original but even surpass it" in the opinion of its proponents (Hübner 1881, 5). These paper archives would also, hoped Mommsen and his collaborators in the CIL, outlast original inscriptions long at risk from war and weather and, more recently, from the construction of roads, railways, and other modern conveniences.

What are glass and paper, among the most fragile and ephemeral of substances, as compared to the durability of stone and the eternity of the stars? Yet in the latter half of the nineteenth century, astronomers and philologists turned to these materials—and to the mechanical (or chemical-mechanical) methods of reproduction they made possible—to create archives that would in the vision of their architects endure for centuries and even millennia. Both the 22,000 glass photographic plates of the Carte du Ciel and the 20,000 paper squeezes

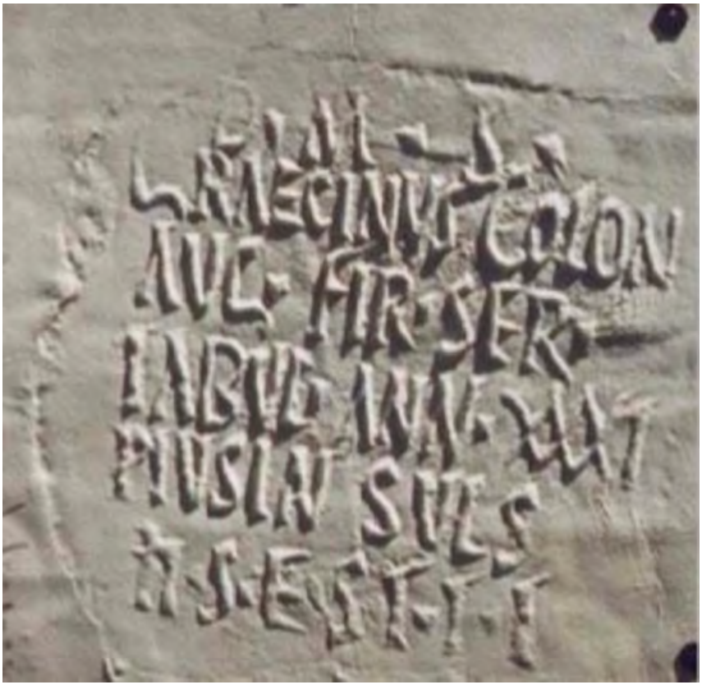

Fig. 2: Paper Squeeze by Emil Hübner of Latin inscription from Écija (Roman Astigi), Spain, CIL II, 1480 "Inscriptiones Hispaniae latinae" (1869–92).

of the Corpus Inscriptionum Latinarum were expected to outlast the starry sky and ancient stones they mirrored. The premise of the Carte du Ciel was that the so-called fixed stars were in fact moving—but at a glacially slow pace that could only be detected by comparing their relative positions in the present and the far future. Never again would the heavens as seen from the earth circa 1900 look precisely the same; there was no stepping twice into the slow-moving river of sidereal time. The glass archive would freeze that moment in time and permit the astronomers of the year 3000 (at least) to track trajectories of known stars, discover new ones, and follow all manner of other celestial phenomena that unfolded on a superhuman timescale.

The philologists behind the Corpus Inscriptionum Latinarum may not have thought in terms of millennia, but they did project their discipline forward to future centuries, secure in the knowledge that the philological study of ancient Greek and Latin languages and literature was already at least a thousand years old. They too were haunted by the fear of losing a key source, Latin inscriptions, to the depredations of time—and by the mid-nineteenth century at a rate that could be all too easily observed in a single human lifespan. As Europe, its colonies, and the Ottoman Empire modernized, the old Roman stones were dug up, smashed, and displaced, effacing the inscriptions and erasing valuable information about original context. Both glass and paper archives were salvage operations, efforts of science present to make science future possible.

This volume is about photo-objects, and for that reason most of this paper will focus on the photographic archive of the Carte du Ciel. But from time to time I will return to the paper archive of the Corpus Inscriptionum Latinarum as an important corrective to claims of singularity made on behalf of the natural sciences as opposed to the humanities and on behalf of photography as opposed to other media. With the Corpus Inscriptionum Latinarum, it was the humanities (not the natural sciences) that invented Big Science; the humble paper squeeze is every bit as mechanical, detail rich, and indexical as the sensitive photographic plate—and every bit as subject to interpretation.

Before the two cultures

Once upon a time but not so long ago, before there were two cultures, there was Big Science—or rather (to use the mid-twentieth-century language of the two cultures) there was Big Science—and Big Humanities. The humanities were in fact in the vanguard: the Corpus Inscriptionum Latinarum begun in 1853 by the Prussian Academy of Sciences was the prototype of many subsequent grand undertakings, including the Carte du Ciel inaugurated at the Paris Observatory in 1887. These two projects were emblematic of the rising prestige of both classical philology and astronomy in the nineteenth century, philologists dazzling the public by deciphering ancient languages and reconstructing ancient texts and artifacts, and astronomers making headlines with sensational discoveries of new planets and ever more precise predictions of orbits and eclipses. The Corpus Inscriptionum Latinarum (known simply as the CIL to all scholars of classical antiquity) and the Carte du Ciel were also emblematic of how the humanities and the sciences during this period shared the practices and priorities of compiling archives for future research, often at the expense of present research. Before there were Two Cultures, made famous by British scientist and novelist C.P. Snow's Rede Lecture of that title at the University of Cambridge in 1959 (Snow 1959),[2] there was a common culture of the sciences of the archives: those human and natural sciences that depend on collections of data and objects in order to pursue research in the present and insure the possibility of research in the future (Daston 2012; Daston 2017).

Berlin, 1858: historian of Roman law Theodor Mommsen, barely forty years old, addresses the Prussian Academy of Sciences on the newly approved Corpus Inscriptionum Latinarum.[3] Mommsen was not yet the celebrated scholar and statesman he would later become, but he lectured the distinguished members of the Historical-Philological Class of the Prussian Academy of Sciences with serene self-confidence in his ability to pull off the Herculean task of collecting all Latin inscriptions from the length and breadth of the ancient Roman Empire—and all this in four years (Mommsen 1905a, 37; Mommsen 1847, 4–8) (see Fig. 3). Although Mommsen did not make good his promise to complete the project within four years, in 1863 he and his team of young philologists began to turn out volume after volume of transcribed Latin inscriptions, producing fifteen folio volumes by 1899.

[2] On the ensuing debate, see Ortolano 2009.

[3] Theodor Mommsen, *Ueber Plan und Ausführung eines Corpus Inscriptionum Latinarum* (Berlin: A. W. Schade, 1847), in *Acta der wissenschaftlichen Unternehmungen der philosophisch-historischen Klasse*, vol. 17a: Sammlungen lateinischer Inschriften, 1836–1848, Archiv der Berlin-Brandenburgischen Akademie der Wissenschaften, PAW-II-VIII.96; Harnack 1900, v. I.2, 896–914; Wickert 1962, 20–64.

Fig. 3: Latin inscription on a wall in Caceres, Spain, CIL II 697.

This was the context in which Mommsen invented Big Science (*Großwissenschaft*), both the word and the activity (Bruch 2005; Rebenich 2005). Addressing the Prussian Academy of Sciences in 1890, he observed that

> [s]cience [*Wissenschaft*, embracing both the natural and human sciences] also has its social problem; as in the big city and big industry, big science cannot be achieved by the lone individual, although it can be directed by one, a necessary element of our cultural development and one whose proper bearers are or should be the academies (Mommsen 1905b, 209).

With generous financial backing from the state, the institutional continuity of the academy, and industrial organization, Mommsen and the Historical-Philological Class of the Prussian Academy pioneered Big Science with project after project throughout the nineteenth century: first the Corpus Inscriptionum Latinarum, then the Thesaurus Linguae Latinae, Byzantine numismatics, prosopography of late antiquity, the Aristotle lexicon, and on and on (Rebenich 1999). Their colleagues in the Physical-Mathematical Class of the Prussian Academy looked on with envy and increasing alarm as, year after year, their humanist colleagues cashiered the lion's share of the Academy's budget for their projects (Diels [1906] 1993, 667).[4] By

[4] At least in the Berlin Preußische Akademie der Wissenschaften, the number of projects conducted by the Philosophisch-Historische Klasse (including Mommsen's) far outnumbered those initiated by the Physikalisch-Mathematische Klasse in the Kaiserreich: Grau 1993, 178–216.

1900, Arthur Auwers, astronomer and Secretary of the Physical-Mathematical Class, was anxiously prodding his colleagues to come up with research projects that could compete with the juggernauts already launched by the Historical-Philological Class. In principle, Auwers insisted, the natural scientists also subscribed to the model of lavishly funded big projects, "Großbetrieb der Wissenschaft," that had brought the Prussian Academy so much fame and fortune. But in practice, Auwers admitted, the scientists had left such glittering undertakings entirely to the humanists.[5]

Auwers was not the only astronomer to have taken note of the triumphant rise of Big Science in philology. Let us now shift the scene from Berlin to Paris. It is April 1887, and the Paris Observatory awaits distinguished guests, the world's astronomical elite, who expected a lavish reception (see Fig. 4). Nor were they disappointed: nine-course banquets and evening concerts leavened the long days of deliberations on whether reflecting or refracting telescopes were best suited to astrophotography and the merits of making a star catalog as well as a photographic map of the heavens.[6] Admiral Ernest Mouchez and subsequent directors of the observatory staged the Carte du Ciel meetings with all the pomp and circumstance of a diplomatic congress, for which the Observatory was decked out with phalanxes of Louis XIV armchairs upholstered in red velvet and galaxies of silver candelabra, all requisitioned from official state storehouses for the occasion.[7] Whenever the French government balked at the mounting expenses, the Observatory director countered that the success of the project was "a point of honor for France."[8]

The 58 astronomers from sixteen countries, plus three colonies, met in Paris and planned what one contemporary called "the greatest venture yet undertaken in astronomy," namely, a complete photographic map of the sky, including all stars to the fourteenth magnitude, made possible by the new astrophotographic techniques pioneered by Edward Pickering at Harvard and the brothers Paul and Prosper Henry at the Paris Observatory (Norman 1938; Hoffleit 1950; Lankford 1984). Only the combined and prolonged efforts of almost a score of observatories in both the northern and southern hemispheres could produce what promoters hailed as an "imperishable monument," a photographic record of "the authentic state of the universe visible from the earth at the close of the nineteenth century." The proportions of the project were indeed monumental: eighteen observatories around the world, from Helsinki at +60.9 degrees latitude to Melbourne at -37.5, labored for decades to amass charts projected in 1912 to stack 32 feet high and weigh about 4,000 lbs. Armed with this snapshot of the sky circa 1900, future astronomers would be able, it was hoped, to detect changes in the heavens which unfolded on too long a time scale to be perceptible within a short human lifetime—the appearance of new stars, nebulae, and comets, the telltale motion of as yet undiscovered planets, the extended periods of variable stars, the incremental proper motions of the so-called fixed stars.

As the deliberations of the 1887 International Congress and of subsequent meetings (1889, 1891, 1896, 1900, and 1909) of the Permanent Committee make clear, the intricate coordination of telescopes, photographic plates, micrometric measurements, and myriad

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[5] Quoted in Grau 1993, 195.

[6] On the Carte du Ciel, see Débarat et al. 1988; Weimer 1987 and Lamy 2008; Débarat et al. 1988.

[7] "Soirées. Dîners à l'occasion des réunions du Comité de la Carte du Ciel." Bibliothèque de l'Observatoire de Paris, MS 1060.IV-A-2-3, Carton 25.

[8] Admiral Mouchez, Directeur de l'Observatoire de Paris, au Ministre de l'Instruction Publique, April 25, 1891, Bibliothèque de l'Observatoire de Paris, MS 1060.IV-A-2, Carton 24.

Fig. 4: Group photograph of the 1887 International Congress of the Carte du Ciel, Paris.

other details to insure that the parts of the map would be commensurable required that participants relinquish control not only over instruments and methods, but also over the choice of research area for decades to come. The levels of sacrifice demanded by the scientific collectivity were enormous: the cost in time and money of new instrumentation and training, the substitution of efficiency for painstaking precision, the monopolization of resources and personnel for long periods of routinized labor, the steadfast resistance to the temptation to neglect old collaborative commitments in pursuit of an exciting new discovery. Some observatory directors, including Pickering at Harvard, judged the costs of collaboration to be too great and declined to participate.[9]

The science of the future

Tons of glass photographic plates and thousands of paper squeezes taken from ancient stones: what the Corpus Inscriptionum Latinarum and the Carte du Ciel produced were not discoveries but the archives from which future discoveries were supposed to come. Under what circumstances does a discipline decide to invest the lion's share of its resources, both human and material, into building an archive for the future rather than in pursuing research in the present?

[9] Pickering did, however, serve on the photometric commission of the Permanent International Committee of the Carte du Ciel: Lankford 1984, 38; E. C. Pickering to E. Mouchez, August 14, 1889.

Classical philology and astronomy are both sciences of the archives, but not in the usual sense of historical archives. Historians consult archives in order to investigate the past; in contrast, the Corpus Inscriptionum Latinarum and the Carte du Ciel were firmly turned toward the future. The proponents of the Corpus Inscriptionum Latinarum and the Carte du Ciel described their projects as “monuments,” the modern age’s answer to ancient pyramids and medieval cathedrals. The form these nineteenth-century monuments took, however, was not architectural but archival: compendia of the working materials that nineteenth-century scholars and scientists imagined would enable their successors to conduct research for centuries (if not millennia) to come. “It is the foundation of historical science,” Mommsen preached to his fellow academicians in Berlin, “that the archive of the past be put in order” (Mommsen 1905a, 37). All future research, whether tracking the development of the Latin language or identifying a new star, would be made possible by the discipline’s carefully assembled archive. At least in the imagination of their founders, the archives are forever.

In contrast, the results of science and scholarship were all too ephemeral—at least that seemed to be the moral drawn from the accelerating pace of progress in both realms by the mid-nineteenth century. As early as the 1820s, the classical philologists had begun to worry about being surpassed and, still worse, forgotten by their own students, as new discoveries and critical methods overflowed the pages of the new journals established to publish them at a faster clip than traditional book presses could keep up with (Turner 1983). A few decades later, their colleagues in the sciences also began to feel time’s hot breath upon their necks. By 1844, Alexander von Humboldt reflected sadly on the fact that “all that is connected with empiricism and with fathoming of phenomena and physical law takes on a new aspect in a few decades … so that as one commonly says, outdated scientific writings fall into oblivion as [no longer] readable” (Humboldt [1844] 1874, xxiv). By 1900, the tempo of scientific advances had quickened to the point that French applied mathematician and physicist Henri Poincaré could write elegiacally about how ephemeral scientific theories had become, describing them as “ruins piled upon ruins” (Poincaré [1902] 1968, 173).

This is the background against which the tremendous disciplinary exertions of the nineteenth-century sciences of the archives on behalf of the future become comprehensible. The scale of cost and commitment demanded by the Corpus Inscriptionum Latinarum and the Carte du Ciel were unprecedented. The investments in time, talent, and money were unprecedented in the history of science; the sacrifices were even greater. The finest young philologists were sent out to transcribe inscriptions in regions where they faced danger and even death. (One of Mommsen’s predecessors, the young Danish philologist Olaf Kellermann, had died of cholera in Rome while gathering inscriptions.[10]) Observatories pledged to the Carte du Ciel tied up resources that could have been used for new instruments and research initiatives for decades to come.[11]

Nineteenth-century archival projects such as the Corpus Inscriptionum Latinarum and the Carte du Ciel stamped the model of the most prestigious, expensive, and “longue durée” science ever after. And I do mean “longue.” Since their inception, regimes rose and fell; two world wars laid waste to large parts of the globe; economic, technological, and political pressures transformed science and scholarship; astronomy and classical philology underwent their own revolutions. Yet, as we will see, these projects survived. What justified such

[10] Mommsen feared a similar fate if he stayed in Italy: Mommsen 1976, 168.

[11] White 1988, 48; cf. Lankford 1984, 32, on the converse advantages to American observatories which did not participate in the Carte du Ciel.

enduring commitments, more binding than treaties, more long lasting than nations, more costly than even the most extravagant monument in brick and mortar? Above all, why labor for an uncertain future, at the expense of an urgent present?

To create and curate an archive is to assume disciplinary continuity, sometimes across centuries or even millennia. There is always a utopian element in the sciences of the archives, a vision of a community that will endure—and cherish the collections so carefully laid up as provisions for future research. Yet in the mid-nineteenth century, when the sciences of the archive invented Big Science and Big Humanities, the rosy vision of science stretching into the far future was shadowed by fear: not the fear that science and scholarship would disappear or fail, but rather that they might succeed too well. By 1850, scientific progress had accelerated to a dizzying tempo: today's established truths could so quickly become tomorrow's errors, and scientific revolutions occurred even more frequently than political ones.

This is the paradox of the first wave of Big Science: never before had the natural and human sciences advanced at such a dizzying speed; never before had humanists and scientists dared to conceive such gigantic projects, spanning continents and generations; never before had governments invested so heavily in the sciences; never before had the sciences been so prestigious as proofs of cultural superiority, both with respect to other European nations and other cultures past and present. Yet the price of all this glittering success was gnawing uncertainty. Would anything from the scientific present be salvaged for the scientific future, or would it all be forgotten, like the science of past centuries—or indeed, past decades? What present science could secure were no longer eternal truths, only the archives of the future.

The accidental trace

These were the conditions of epistemological uncertainty that persuaded generations of philologists and astronomers to dedicate themselves and the resources of their institutions to these gigantic archival projects for the future. No-one knew how long the current doctrines of the discipline would last; no-one knew the directions that future research would take. These uncertainties were engraved (sometimes literally) in the materials of the archive. Here, I will concentrate on the Carte du Ciel because it generated a photographic archive, with only an occasional side-glance at the CIL.

Without a doubt, it was the invention of astrophotography that made the Carte du Ciel conceivable, most spectacularly demonstrated in the images obtained by the brothers Henry with their refracting telescope at the Paris Observatory. Even the Americans, who had made the first astrophotographs (Draper 1864),[12] were impressed: "they [the Henry brothers' lunar photographs] surpass everything I have yet seen," enthused the director of a Pennsylvania scientific instrument firm, "and I have seen the photographs of Prof. E. C. Pickering [of Harvard]"[13] (see Fig. 5). Innovations in gelatin dry plates, which had far lower exposure times, and the Eastman method of manufacturing glass photographic plates coated with the new silver bromide emulsions dissolved in gelatin, greatly expanded the scope of astropho-

[12] For the photographic initiatives of Edward and William Pickering at the Harvard College Observatory, see Sobel 2016.

[13] J. A. Brashar to Paul and Prosper Henry, September 9, 1890, Papiers des frères HENRY, MS 1133-1, Bibliothèque de l'Observatoire de Paris.

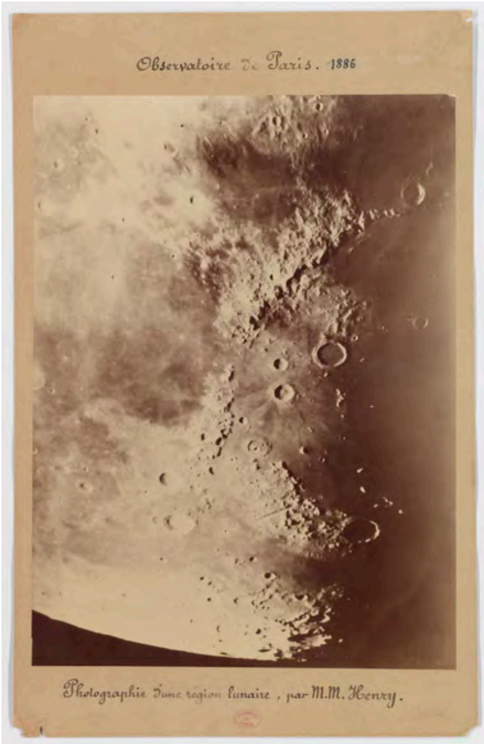

Fig. 5: Photograph of the moon, M. M. Henry, 1886, Observatoire de Paris.

tography (Lankford 1984, 22–23). For the purposes of the Carte du Ciel, the promise of astrophotography was threefold: the possibility of capturing millions of stars with immeasurably less effort and greater precision than by traditional methods of observation, measurement, and drawing; the greater sensitivity of the photographic plate, which could, with sufficiently long exposure times, register stars too faint to be captured by the human eye even as fortified by the telescope; and the mechanical objectivity of the plates, which would preserve details that a human draftsman might overlook as insignificant but which later—a decade, a century, a millennium hence—might turn out to be of urgent scientific interest. The mantra "untouched by human hands"[14] had a double meaning in the context of the Carte du Ciel: on the one hand, emancipation from "long and tedious observations," and on the other, suppression of any subjective impulse to edit out the apparently accidental.[15]

Historians of science and photography have been understandably skeptical about such claims to mechanical objectivity. They rightly point to the inevitability (and desirability) of human intervention at every stage of making a photographic image, from choice of equipment and emulsion to composition to development to reproduction in print (Tucker

[14] "No hand of man has tampered with these pictures," David Gill, "The Applications of Photography in Astronomy," lecture to the Royal Institution, June 3, 1884.
[15] Pierre Jules Janssen, quoted in Winterhalter 1889, 23.

2005; Wilder 2009). Without these skilled interventions of the human hand, eye, and mind, the images would be scientifically useless. But these well-taken points do not imply that nineteenth-century scientific enthusiasm for images produced effortlessly and impersonally was mere rhetoric: such claims must be assessed in comparison to existing alternatives for producing images, not some absolute standard of autopoiesis. In the case of images of the astronomical objects or ancient inscriptions, the alternatives were laborious indeed, with a considerable margin for interpretation and plain old error. Mapping stars (or transcribing ancient transcriptions) by hand required unimaginable levels of precision and attention to detail, especially detail that appeared meaningless to the observer at the time but that might turn out to be full of significance for future researchers (Nasim 2013). No wonder the astronomers waxed euphoric over the possibilities of astrophotography.

But however great the advantages of dry, gelatin-coated glass plates over manual star-mapping were, there was a hitch: in order to justify the international and trans-generational scale of the Carte du Ciel, the results of the sky map would have to be made available to astronomers everywhere by publication, and heliogravure (also known as photogravure) methods altered the stellar images in alarming and unexpected ways.[16] True to the spirit of preserving every detail in the photographs, no matter how apparently accidental or insignificant, the Permanent Committee of the Carte du Ciel laid down the iron rule that the images must under no circumstances be retouched. Yet even the most experienced (and expensive, at 200 French francs a plate) photogravure firms encountered maddening and mysterious difficulties in reproducing Carte du Ciel plates. Some of the faintest stars disappeared in certain parts of the copper plates; the distances between some stars were distorted; printing altered the magnitudes of some stars and even created others with no counterpart on the plate, because of irregularities in the way paper absorbed ink from the copper plate (see Fig. 6).[17] The problems were so grave that the best French heliogravure firm, Dujardin, quit because the ban on retouching faint stars compromised the quality of the work, thereby giving up a lucrative commission that promised to continue for decades.[18]

The photographic plates had also been a source of headaches—there was endless debate over whether the emulsion and exposure times could or should be standardized, whether the uniformity or sensitivity should be prioritized in choice of emulsion (uniformity won), whether the grid (*réseau*) imprinted on the plates would distort or obscure stars, whether the emulsion would deteriorate with time, whether each observatory should store its own plates or whether a central bureau of the Permanent Committee should test all plates and preserve them.[19] But the organizers of the Carte du Ciel thought they had a back-up archive. They hoped that the far sturdier and chemically more stable copper plates from which the pho-

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[16] On heliogravure techniques of reproduction, see Nadeau 2008.

[17] "Carte Photographique du Ciel. Observatoires français [1898]," Trépied to Observatoire de Paris, March 14, 1901, Bibliothèque de l'Observatoire de Paris, MS 1060 IV-A-2; Documents imprimés non inserés aux procès-verbaux [of the April 1909 meeting of the Permanent Committee], Bibliothèque de l'Observatoire de Paris, MS 1060-IV-A-2, 4e Partie/Boite 24.

[18] "Congrès 1909. Rapport au Ministre après le Congrès," Bibliothèque de l'Observatoire de Paris, MS 1060-IV-A-2, 4e Partie/Boite 24. In a letter to the Minister of Public Instruction dated April 21, 1898, the director of the Paris Observatory Loewy confided that the costs of publishing the plates would probably total 1,500,000 French francs and perhaps take as long as a century: "Correspondence du Mars 1894–Avril 1900," Bibliothèque de l'Observatoire de Paris, MS 1065.

[19] Concerning the réseaux, W. H. Christie to E. Mouchez, May 17, 1892, Bibliothèque de l'Observatoire de Paris, MS 1060-V-A-2/ Boite 29; concerning the standardization of plates and the desirability of a central bureau, David Gill, "Notes for the réunion of the Permanent Committee [1889]," Bibliothèque de l'Observatoire de Paris,

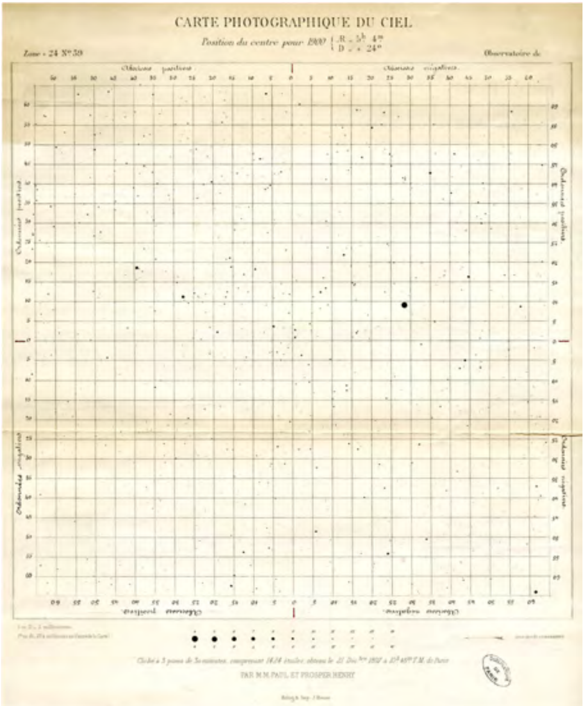

Fig. 6: Heliogravure of Carte du Ciel photographic plate, courtesy of Bibliothèque de l'Observatoire de Paris.

togravure publication of the sky map would be printed would perfectly duplicate the finicky glass plates. Now it was the more robust copper plates that would allegedly provide an "inalterable... [and] rigorous inventory of a part of the sky at the beginning of the twentieth century" left to "the generations to come," as Benjamin Baillaud, Director of the Paris Observatory, boasted to the Minister—in the same breath in which he presented the staggering one-million-franc price tag for this duplicate archive.[20] The hobgoblins that bedeviled the copper plates struck a triple blow to the Carte du Ciel: the costs skyrocketed beyond what even the wealthiest observatories could afford; the dream of a second, more durable archive of copper rather than glass evaporated; and all of the labor saved by replacing drawing by photography would now be expended in the still more mind-numbing and error-prone task of proofreading the copper plates and print proofs against the photographic plates, dot by tiny dot.[21]

MS 1060-IV-A-2/ Boite 22; concerning the deterioration of the film, I. Roberts to F. Tisserand, April 1, 1896, Bibliothèque de l'Observatoire de Paris, MS 1060-IV-A-2/Boite 22.

[20] "Congrès 1909. Rapport au Ministre après le Congrès," Bibliothèque de l'Observatoire de Paris, MS 1060-IV-A-2, 4e Partie/Boite 24.

[21] "Documents imprimés non inserés aux procès-verbaux [of the April 1909 meeting of the Permanent Committee]," Bibliothèque de l'Observatoire de Paris, MS 1060-IV-A-2, 4e Partie/ Boite 24: "Avant de donner le bon à

No matter how painstaking the proofreader, this process was bound to introduce accidents of both commission and omission into the printed images. These were no longer the accidental traces preserved by the impersonal, indiscriminate medium of the photographic plates, however; rather, they were the artifacts of film, photogravure, and the human eye acting in unintentional and unpredictable combination. The photographic accidental trace, so pregnant with future discoveries in the minds of the moving spirits behind the Carte du Ciel, was in danger of being swamped by all manner of other accidental traces, all of them unintentional but none having anything to do with the starry sky. No wonder the Carte du Ciel was never finished.

Conclusion: morals from the tale of two archives

What was the fate of these two grand scientific archives of the nineteenth century? Both were almost shipwrecked by two world wars and the havoc wrought with international scientific collaboration by national hostilities. If anything, the Corpus Inscriptionum Latinarum was the harder hit of the two, since it was centralized in Berlin, the capital of the country that lost both world wars and was largely destroyed by allied bombing during the second one. War, imperialism, modernization, and the vicissitudes of time and weather took a further toll on the original inscriptions themselves; at least the stars were safe from earthly mayhem. When Germany was divided into East and West and then reunited, the CIL suffered the further disruption of migrating first to the German Democratic Republic and then, after reunification and the dissolution of the East German Academy of Science, to the Federal Republic of Germany. Yet it is the CIL, now housed at the Berlin-Brandenburg Academy of Sciences and Humanities, which ultimately survived and continues to publish new volumes of inscriptions.

The Carte du Ciel catalog, giving positions of all stars down to the eleventh magnitude, was eventually completed (the last installment was published in 1962), but it was rarely used because of the inconvenience of converting rectangular coordinates to the customary right ascension and declination. The actual Carte du Ciel, the map of the sky, was never finished, bogged down by all the difficulties surrounding the publication of the photographic plates. For much of the twentieth century, the Carte du Ciel was an embarrassment to astronomers: a vast waste of labor and money and the ruin of the observatories that had remained loyal to the project and been left behind in what turned out to be the century of astrophysics. It had become a Sleeping Beauty archive, its photographic plates slumbering in the dustier corners of the world's observatories.

But around 1990, Sleeping Beauty awakened. By comparing the positions of the Carte du Ciel catalog with those of the new Tycho catalog made with data from the European Space Agency's Hipparcos satellite, it was in fact possible to calculate the proper motions of almost a million stars, just as Mouchez and the other initiators of the Carte du Ciel had hoped (Jones 2000). Far more surprising, yet expected precisely because it was so unexpected, was the evidence supplied by the Carte du Ciel photographic plates for the existence of dark matter, which can only be inferred from its gravitational effects because it does not interact

tirer, les astronomes comparent étoile par étoile l'épreuve au cliché original, et notent toutes les remarques qui peuvent intéresser ceux qui serviront de ces cartes."

with electromagnetic radiation.[22] This was exactly the sort of accidental trace the monumental scientific archives projects of the nineteenth century had counted on: the predictable unpredictable.

These are phenomena familiar to historians of photography: Kelley Wilder has written perceptively about the "collect-everything" impulse that characterized scientific archives in conjunction with photography at the turn of the twentieth century (Wilder 2009, 79–80); Robin Kelsey has flagged William Talbot's fascination with the accidental details revealed retrospectively by his photographs (Kelsey 2008). But these features are not medium-specific, and neither are the fantasies associated with reproduction so perfect that it preserves even imperfections. The paper squeezes of the CIL, which also miraculously survived two world wars, the demise of Prussia, the division and reunification of Germany, and numerous disciplinary upheavals in classical philology, aspire to be just as blindly mechanical in their mode of reproduction as the Carte du Ciel's photographic plates. And like the photographic plates, the squeezes hold out the promise of answers to questions never dreamed of by the CIL's originators. The misspellings, abbreviations, and other infelicities of the stonecutter that a transcription might have silently corrected have become precious sources for tracking regional variants of spoken Latin in the hands of a later generation of epigraphers. Like the published heliogravure plates of the Carte du Ciel, the published transcriptions (and increasingly photographs) of the originals were essential to making the CIL into a much-thumbed reference work for philologists worldwide. But as in the case with the Carte du Ciel, behind these published compendia stand the real archives, the glass plates and the paper squeezes, slumbering in cabinets and drawers until an unforeseen question suddenly awakens them into relevance (see Fig. 7).

Every new medium conjures up its own archival fantasies. In the sixteenth century, the printing press inspired dreams of a universal library containing every book ever written. In the nineteenth century, photography fired imaginations with Borgesian visions of perfect reproductions of everything, stored forever on glass plates, neatly boxed and labeled (Edwards 2012). In the twentieth century, film and microfiche nurtured schemes like Albert Kahn's Archive de la Planète and Paul Otlet's Bibliographie universelle (Amad 2010; Otlet 1906; Lemov 2015). In the twenty-first century, digitalization has once again plunged both the sciences and the humanities into archival delirium, as projects to create warehouses of data to serve future research once again channel funding and energy away from present research. Notoriously, the very material properties that ignite such fantasies in the end undermine them in the end: the magical ability of photographic plates to capture dazzling detail in split seconds is subverted by the fragility of glass and the unstable chemistry of emulsions; the compactness of microfiche is neutralized by crumbling celluloid and unwieldy readers; the vast capacity and swift searchability of digital databases is countered by electricity-gobbling servers and outmoded hardware (does anyone remember the floppy disk?). It is as if some nemesis inherent in each new medium ultimately is its own undoing, like the tragic flaw of a Greek hero. But no disappointment in past technology seems to dim the phantasmagoric hopes attached to the latest technology that promises to preserve everything, faithfully and forever.

Where do such fantasies of a perfect medium come from, and why are they so resilient in the teeth of experience and evidence? Historians of photography have pointed out sug-

[22] Frédéric Arenou and Catherine Turon, "(Cent ans après...) Hipparcos, une troisième dimension pour la Carte du Ciel," in Lamy 2008, 177–211.

Fig. 7: Original envelope for Potsdam Carte du Ciel photographic plate, courtesy of the Leibniz-Institut für Astrophysik, Potsdam.

gestive analogies between legends of magic mirrors or the veil of Veronica and the myths that stubbornly cling to photography, despite over a century of efforts by practitioners and historians to demystify the medium (Geimer 2011). But these fantasies are far older, dating back at least to Aristotle and a metaphor that haunts the history of epistemology (and the history of reproductive biology): the seal imprinting soft wax. Aristotle invokes this metaphor to explain both how perception faithfully conveys information about the world to the mind (Aristotle n.d.(b)) *and* how the traits of the parents (particularly of the father) are reproduced in the embryo at the moment of conception (Aristotle n.d.(a)). In both cases, the mechanism depends on detaching form from matter.

For millennia now, the dream of the perfect copy has depended on the philosophical habit of separating form from matter. Long after seals and wax were replaced by print impressed on paper, then light chemically fixed on film, and now electronic impulses coded into LED computer screen displays, the Aristotelian conviction that form is independent of and superior to matter lingers. Whether we read texts in stone or on paper, view images of paint on canvas or as pixels on screen, our default stance is to extract form from matter. Perhaps this is why the very material properties that make new media so stimulating to the imagination paradoxically breed fantasies that obliterate those same material properties.

Nowhere is this amnesia more glaringly on display than when old media are in the process of being converted to new ones. In the case of the Carte du Ciel plates, the promise of automating the analysis of tens of thousands of plates and sharing data among astronomers worldwide is fueling efforts to digitize all the surviving glass plates stored in the world's observatories (see Fig. 8). Although there is little reason to think that either current hardware or software will prove more long-lasting than glass plates, astronomers now envision the archive of the future as digital. The squeezes of the CIL are also being digitized. So far, no-one is talking about discarding either plates or squeezes. But if the past history of scientific archives is anything to go on, fantasies of form will eventually prevail over the gritty reality of matter.

Fig. 8: Envelope of Carte du Ciel photographic plate that has been digitized, courtesy of the Leibniz-Institut für Astrophysik, Potsdam.

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Fig. 7: Original envelope for Potsdam Carte du Ciel photographic plate, courtesy of Leibniz-Institut für Astrophysik, Potsdam.

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