Humanity's Hope: History of Science in the Golden Age of Learning

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A generation ago the critic George Steiner began his classic reassessment of T. S. Eliott's *Notes toward the Redefinition of Culture* by observing: "Each new historical era mirrors itself in the picture and active mythology of its past or of a past borrowed from other cultures." He continues: "Most history seems to carry on its back vestiges of paradise. At some point in more or less remote times things were better, almost golden." In full he observes:

> In current Western culture or "post culture," that squandered utopia is intensely important. But it has taken on a near and secular form. Our present feeling of disarray, of a regress into violence, into moral obtuseness; our ready impression of a central failure of values in the arts, in the comeliness of personal and social modes; our fears of a new "dark age" in which civilization itself, as we have known it, may disappear or be confined to small islands of archaic conservation—these fears, so graphic and widely advertised as to be a dominant cliché of the contemporary mood—derive their force, their seeming self-evidence, from comparison. Behind today's posture of doubt and self-castigation stands the presence, so pervasive as to pass largely unexamined, of a particular past, of a specific "golden time."

Steiner locates that nostalgia in the nineteenth century, the very time harboring the "origins of the inhuman, of the crises of our own time that compel a redefinition of culture."[1] With apologies to Steiner, I propose to locate the Golden Age of scholarship early in the twentieth century, at first glance an unpromising time for it, given the magnitude of atrocities it witnessed in the name of civilization.

Silently present throughout Steiner's analysis is the spirit of Walter Benjamin's Angel of History, seeing catastrophe and destruction but unable to intervene because she is being blown backwards into the future by the same divine wind from paradise that animates the horror.[2] But whereas Benjamin proposes a rectification of hopelessness in an obligation to give life to the unrealized hopes of the past (and in this way invests in the dead past a moral claim on the present), Steiner identifies science as an antidote to *Kulturpessimismus*.[3] At the outset of his inquiry Steiner cites Thomas Babington Macaulay's essay of 1837 on Francis Bacon (to which he might have added Ernest Renan's *Avenir de la science*). He concludes with a tentative affirmation that, notwithstanding the crimes committed in its name, science is oriented optimistically toward the future: For the humanist, "the essential repertoire of his consciousness, the props of his daily life as a scholar or critic are from the past," but "for the scientist time and the light lie before." For Benjamin, hope is fleeting and mysterious; for Steiner, hope shall be transmitted to humankind by historians of science, who are able to forge a synthetic future culture.[4] Again with apologies to Steiner, I shall contend that the Golden Age of scholarship radiates this optimistic view of science past.

We owe to Hesiod the location of the Golden Age as a paradise in the remote past, when a race of mortals lived in peace, happiness and abundance. The second age of humankind, the Silver Age, began when Pandora opened her box and freed the host of vexations who had been imprisoned there. Then on to the bronze and heroic ages, each one progressively worse, until the Iron Age of Hesiod's own time, filled with incessant labor and sorrow and marked by ignominious and uncelebrated death. This perennial nostalgia for the Good Old Days, present at the dawn of Greek poetry, may be an artifact of memory, which tends to suppress pain in favor of focusing on pleasure, but it is useful to recall that Hesiod's monotonically decreasing graph of cultural evolution is not the only picture that has come down to us. In dark times, writers hoped for a brighter future. That is, if for Cicero, Tacitus, and Sallust politics focuses not on the best government, in the tradition of Classical Greece, but on the legitimation of power, if the traditional moral authority of the Res Publica has disappeared, then the Golden Age lies not in the republic of the past but rather in the republic of the future; if for Saint Augustine and Thomas More, as for the *marquis* de Condorcet, one's city or one's life

is threatened with destruction, the Golden Age of redemption is still to come.

The examples of More and Condorcet suggest that the spirit of revolution can engender fables of a future perfect. This is clear even in the last part of the twentieth century, which has become known as a time of pessimism leading to the denial of all Enlightened tenets—notably the existence of truth and facts on the one hand and universal human values on the other hand. In 1969, inspired by the Free-Speech Movement at Berkeley and the Counterculture generally, the distinguished molecular biologist Gunther Stent contended that technological advances heralded a Golden Age in the image of a psychedelic, Polynesian-styled paradise, where hard labor and disease shall be unknown, and where, as well, the impulse to innovate shall fade away.[5] This view has not come to pass, of course, even though it is promoted by prominent writers with an anti-technocratic bent, such as John Ralston Saul and Václav Havel.[6]

By identifying the first part of the twentieth century as a Golden Age of learning, I do not mean to suggest that everything in this time is of great value or significance. A consideration of the great mass of inaugural dissertations produced in Europe over the years 1895-1925 is sufficient to disabuse even the most enthusiastic supporter of such a thesis.[7] Yet we recognize those works as near-contemporaries in style, structure, and *apparatus criticus*. Writers active in that time are discussed today with an immediacy that is redolent of nostalgia. Beneath my identification of this Golden Age is the thought that some of its features—notably the search for truth and a sense of ecumenism—can usefully be kept in mind by writers today. That prospective, which is best done cautiously, is for another place. The past is not a beast of burden for carrying one's hopes into the future. (In a television interview from many years ago, writer John Updike quoted Voltaire: When you set off on the road to posterity, travel light.) Furthermore, rehabilitation is just short of rebirth, and we may be cautioned by Arnold Toynbee's remark that all calls for a renascence depend on the dark art of necromancy.[8]

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In commenting on the history of religious missionaries over the past several centuries—among whom are found the most vigorous promoters of the imperial designs of European powers—Ryan Dunch has recently challenged the explanatory value of cultural imperialism. He seeks to transcend three limitations of what is, evidently, a diffusionist model of authority. The first limitation concerns a reification of "national or cultural authenticity"; the second limitation is a neglect of the culture that is subject to diffusionist pressure; the third limitation involves the laminar flow of diffusion, reducing "a complex set of interactions to a dichotomy between actor and acted upon." Dunch contends that missionaries "foster cultural differentiation in the very act of disseminating concepts claiming a 'universal' validity, whether...religious concepts or constituent elements of what would become global modernity."[9] Without going afield in discussions about Aristotelian and biological kinds (When is a "Baptist" church no longer a Baptist church?), it is appropriate to ask whether all ideas spread in the way Dunch imagines. In particular, when ideas about the natural world move from one civilization to another, does their expression take a fundamentally new form?

However persuasive culture-relative commentary is for dealing with sophistical agency centering on allusion, prayer, and revealed truth—that is, the legions of religious, political, and literary ambassador—it seems inapplicable to rational agency based on quantification, observation, and demonstration—notably physicists and astronomers in the nineteenth and twentieth centuries. Religious groups continually revise their affiliations and consanguinity as cultural variation provokes schism—the creation of another faith. Notable current instances include Catholic liberation theology in Latin America and the Episcopal ordination of homosexuals in the United States. Whereas medicine harbors astonishing variations in paradigm, even within one regime of heath care, differentiation within the exact sciences—to the extent that it exists at all—is of another kind. There have been no challenges to the periodical chart of the chemical elements or the laws of thermodynamics by physicists in Argentina or China; and although geocentrism continued to be taught in early twentieth-century Morocco and perhaps also in other settings like Indonesia, India, and New Mexico, astronomers in Texas or Tokyo have not recently challenged Copernicus. I have consistently argued that this feature of the exact sciences—which might be called invariance—allows them to carry prestige and serve the imperial interest of metropolitan authorities.[10] If a precedent is required, then one may look to the way that Pericles justifies the empire of Athens, in part on Athenian art and philosophy: "Taking everything together then, I declare that our city is an education to Greece."[11] Whether one likes it or not, quantum mechanics was forged and is now taught with tools developed for the most part in Western Europe. To the extent that fields of study like immunology and paleontology embrace the Baconian tools of mathematics and experiment, they too seem to be highly resistant to cultural variation.

Almost by definition, any notion of cultural imperialism revolves around apparently impractical goods and immaterial topoi, such as Jurassic botany or interstellar astronomy. If they are based on verifiable discourses (this leaves out spiritism and psychoanalysis, for example), we may imagine that other erudite enterprises carry cultural authority in

the same way as physics. To see how this works, we have only to consider German historical practice in the nineteenth century and French historical practice in the twentieth century, for the immense prestige of those traditions has kept scholars in the United States—arguably the largest community of practising historians—from developing an independent historiography. The disturbing effects of a great historiographical tradition, the momentum carried by its concepts, the inertia of its prejudices—these visible manifestations of cultural imperialism are what drew the attention of Edward Said in his essay of 1978 on Orientalism, where he laments a tradition of scholarship that, in his opinion, denigrates the Oriental, more particularly the Arab world.[12]

To a certain extent Edward Said did not write about historians *sui generis*, restricting his view largely to the English and French ambit. No one can study everything, and the focus is not unreasonable, but it should be apparent that a look at literature written by German-speakers at the time of National Socialism—a regime that has provided the type specimen for policies of cultural and racial exclusivity—is sufficient to raise questions about Said's thesis. Hermann Hesse and Elias Canetti received the Nobel Prize in Literature largely for novels about academics steeped in Oriental culture. The works have distinct tones: Hesse's protagonist Josef Knecht in *Das Glasperlenspiel* is treated sympathetically, while Canetti's protagonist Peter Kien in *Die Blendung* is a bitter satire. Both novels question the value of scholarship generally and the German research ethic in particular, but there is not a hint of caricature or patronizing about Chinese civilization.

The centerpiece of Said's thesis concerns how scholars for over three centuries systematically discounted the history and the integrity of Islamic civilizations. In his principal indictment, Edward Said tars Islamic scholars in Europe and North America with the brush of racism, in the view of two sympathetic critics condemning the entire field of study for its lack of humanity and dispassion on the one hand and on the other hand for inventing the notion of an Oriental spirit and then imposing it on conquered lands.[13] Said, however, is ambivalent about the value of *all* Orientalist scholarship. He writes:

> What I am describing, then, is something that will characterize Islamic Orientalism until the present day: its retrogressive position when compared with the other human sciences (and even with the other branches of Orientalism), its general methodological and ideological backwardness, and its comparative insularity from developments both in the other humanities and in the real world of historical, economic, social, and political circumstances.

The Orientalist believed

> that for the Oriental, liberation, self-expression, and self-enlargement were not the issues that they were for the Occidental. Instead, the Islamic Orientalist expressed his idea about Islam in such a way as to emphasize his, as well as putatively the Muslim's resistance to change, to mutual comprehension between East and West, to the development of men and women out of archaic, primitive classical institutions and into modernity.[14]

The Orientalist was racist.

Who was not racist one hundred years ago? Racism was a structural feature of European and North American civilization before 1914, and especially because of the association between race and nation (notably among French writers), few scholars—whether philologist, historian, or chemist—had the presence of mind to reject it. A real question nevertheless remains: Does useful knowledge follow from the labor of Europeans writing about Islam and Asia, or should the enterprise be relegated to the domain of Mesmerism, phrenology, and extra-sensory perception?

Enlightenment writers by no means minimized the accomplishments of the Islamic world in manufactures and works of art; for them, Islamic rule was no more authoritarian or whimsical than rule under the Old Regime in France. With the French Revolution came Modernity, symbolized by trousers and top-hats. Modernity helped define both Medievalism, for example, in the Gothic style of architecture and writing, and also Classicism, the veneration of Greek culture that found a name in Neohumanism. But these notions are the speculative fantasies of impractical people. The force of modernity came through the Industrial Revolution, which transmuted Enlightenment reason, clarity, and elegance into crude doctrines of material and social progress, finding issue in utilitarianism, positivism, social Darwinism, and pragmatism. With these doctrines came a discounting of civilizations beyond Europe at just the time that Europe devastated them.

Science and technology are independent and interacting enterprises, even though perceptions of the relationship between them varies over time. Although today technology dominates higher learning to the extent that science is now sometimes seen as an application of it, in the nineteenth century, science—that which appeared as *Wissenschaft* in German universities—was held to be anterior to technology; science, understood as a Baconian search for natural laws through experiment and mathematics, was widely seen as the key to material progress.[15] In part for this reason, civilizations were arranged on a phylogenetic tree according to their apprehension of science. By the end of the

nineteenth century, the West was synonymous for the set of nations with a scientific outlook, those sitting at the highest part of the tree. From this point of view, much of the New World—from Toronto to Mexico to Quito to Buenos Aires—was Western; so was Japan. In all these settings, one surveyed earth and sky in comparable fashion; one used radiation and chemicals to probe the microscopic world; one generalized using algebra, statistics, and calculus.

The prosecution of science, late in the nineteenth century, became a justification for maintaining client civilizations. Scientific activity served as a territorial marker and as a universally recognized concomitant of the civilizing mission, for science was held to be accessible to all suitably prepared minds. In the Age of Imperialism, no other argument carried a transnational ring of authenticity. (The argument of proselytizers—Christianizing the world—is not really an argument at all, given the schisms in dogma among Christian churches.) Of course in the nineteenth century, conquest proceeded from swinishness—the quickest route to riches is theft, whether of goods or labor—and European elites robbed the world. Intellectuals, in their role as *chiens de basse cour*, scurried to justify their privileged status, benefitting as they did from this savage exploitation. For them, superiority through science had a clearer ring than superiority through beauty or music or poetry. Telling the story of that superiority became the mission of historians of science at the dawn of the twentieth century.[16]

Several points require emphasis. First, that an idea is enlisted in the service of inhuman ends does not falsify the idea. The differential and integral calculus are not wrong because they are used in constructing intercontinental ballistic missiles, although the people who make the weapons are subject to our censure. Second, an idea is not wrong because a bad person proclaims it. That Charles Darwin was a racist is not a reason for rejecting natural selection. Finally, although I shall criticize the currently fashionable denial of the universality or truth of science, my argument about historians of science is able to encompass that pessimistic doctrine as well as Joseph Needham's metaphor of modern science as a great river fed by many tributaries flowing into the ocean of truth.

Just as all thinkers in medieval Christian Europe were not driven to inaction by religious dogma, so all nineteenth-century European scholars did not undervalue views of nature in eastern and southern civilizations. The present political conjuncture in Mesopotamia invites one example: Josef Epping's deciphering of cuneiform planetary ephemerides in nineteenth-century Quito, an accomplishment that led to the first reliable chronology of antiquity in the Mediterranean world.[17] Another example is the deciphering of Demotic and hieroglyphics. Later in the century came studies of antiquities at Angor Wat and Borobudur, among many others.[18] Elaborating monuments of the past contributes to the prestige of the elaborator, and recovering the past serves to include overseas territory into a particular cultural ambit, whether Dutch, German, French, or English. Yet to benefit the ends of empire, scholarship must nevertheless possess a general, transnational content; otherwise, it is perceived in its own time as nothing more than chauvinist rhetoric.

The contributions of scholars to English, French, German, Dutch, and Italian periodicals in the nineteenth century contain offensive characterizations of nations and cultures—both within and beyond Europe. But it cannot be denied that among the contributions are many fair and reasoned analyses of Islamic, South Asian, and East Asian texts in science.[19] In fact, it is fair to say that knowledge among Europeans of medieval *European* science proceeded apace with knowledge about Islamic science. Late in the nineteenth century, there is a complementarity about the shortcomings of Pierre Duhem's research into science at medieval Paris and Marcellin Berthelot's studies of Islamic alchemy (it is relevant to observe that Duhem was one of the most vociferous detractors of German learning during the First World War).

Why did the inspired fruit of isolated nineteenth-century efforts at fathoming Islamic science grow into a cornucopia of interest in Europe over the early decades of the twentieth century? In the spirit of the celebrated thesis of Eckart Kehr on national politics as the origin of international policy, it is reasonable to posit that early twentieth-century interest in Islamic science is an effect not of imperialist aggression in Africa and Asia but rather of general trends in higher learning, notably the dramatic expansion of universities and widespread adoption of the German research ethic. All manner of specialized inquiry received attention, from molecular physics (Albert Einstein's doctoral dissertation) to medieval romance (the doctoral dissertation of Einstein's sister Maria Winteler-Einstein). The burgeoning literature could barely be surveyed, much less controlled by academic cliques or "learned societies." These circumstances alone suggest the limitations to a conspiracy of malevolence that governed "Oriental" studies.[20]

We are fortunate in having a record of the European study of Islamic science over the period when Edward Said claims scholarly Orientalism was at its height. It is found in the publications of George Sarton (1884-1956), the early twentieth-century promoter of history of science as a specialist discipline. For nearly 40 years Sarton edited the periodical *Isis*, to which he contributed some 10,000 bibliographical entries—sometimes with extensive commentary. The periodical furnished sources for his systematic introduction to the history of science, which he ended with the

fourteenth century. Sarton was a scholarly generalist in a milieu that valued highly specialized research, but he learned enough Arabic to deal with primary and secondary material and to become the center of an international group dedicated to understanding science in medieval Islam. Historian of Islamic science Max Meyerhof, for example, writes from Cairo in 1927 to congratulate Sarton in English on the first volume of his *Introduction*, "a wonderful, an astonishing creation! You did alone the work which in other comprehensive publications is done by a dozen of scientists, and you did it in the most competent manner. I am surprised to see how closely you followed p.e. the Oriental literature. There is nearly no matter of any importance omitted by you."[21] Twelve years later Meyerhof spoke for a dozen of his Arabist colleagues when he writes that Sarton is "in nearly everything 'our spiritual leader.'"[22] Sarton was not the foremost scholar in the group, but he was its buccinator. A review of his periodical and his writings reveals that Western historians of science labored to achieve a critical and balanced assessment of Islamic science over the first half of the twentieth century. Their work provided a model for Joseph Needham's extraordinary survey of Chinese science. If, as one commentator has written, Needham is the modern Aristotle, Sarton's circle is the Academy.[23] Needham indeed deferred to his predecessor. He writes in 1954: "An enquiry from Sarton takes VIP precedence over all other business."[24]

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George Sarton matured in his native city of Ghent just at the time that Belgium acquired a large portion of central Africa as a colony. If there is an example of science as a Trojan horse for political domination, then surely the Belgian Congo is paradigmatic, for the colony originated in the International Association for the Exploration and Civilization of Africa, called into being in 1876 by King Leopold II; if there is an example of science serving the needs of manufacturing, then it is surely August Kekulé von Stradonitz's arrival in 1858 to teach chemistry at Ghent, a center of the Flemish weaving and dyeing industry; and if there is an example of working-class socialism coupled with linguistic nationalism, then early twentieth-century Ghent is the place to find it. These currents, coupled with avant-garde Belgian Symbolist art and literature and art-nouveau interior design (for example, in the work of Victor *baron* Horta), all contributed to Sarton's outlook.[25]

Sarton's interest in things Oriental emerged in his early twenties. In his agenda on 4 May 1904 , he notes an article on Japanese painting, and he is the likely author of a poem in the same year about a Japanese legend recounting a woman who suffers the death of her lover.[26] In 1910, George visited London and toured the exhibit of Japanese art at Shepherd's Bush. "It nearly took me off my feet," he recalls late in life. He went to the Indian Museum in South Kensington; he met Arthur Henry Fox Strangways, an expert on Hindu music and art, and Ananda Kentish Coomaraswamy, a specialist of Hindu and Indonesian art who in 1917 became curator at the Boston Museum of Fine Arts. Both men, internationally recognized authorities on Oriental culture, contributed to Sarton's journal *Isis* and remained his friends to the end of their life.[27] Soon after his marriage, George wrote in his diary on 1 September 1911 that he has decided "to devote my life to the history of science." His light comes from the east: "The Orient—all intellectual manifestations of the Orient, art and science—attract me. I feel that I am a bit Oriental. Perhaps I will study later the science of Egypt and Chaldea more closely."[28]

Among Sarton's earliest and strongest supporters was David Eugene Smith, historian of mathematics at Teachers College of Columbia University in New York. When Sarton was planning for the first number of *Isis*, Smith offered to provide an article on Japanese mathematics of the Seki school or on indigenous Hindu geometry.[29] Smith volunteered to send out sample copies of *Isis* at his own expense, along with a covering letter of his own.[30] An early and enthusiastic supporter of *Isis* was also the Orientalist Paul Masson-Oursel, an expert on Buddhist thought.[31]

George Sarton was surely an idealist when in July 1914, oblivious of the impending war, he and his wife visited London. Motivating the visit was Sarton's fervent desire to learn more about South Asia. Sarton met again with Coomaraswamy. Sarton planned to devote no. 6 of *Isis* exclusively to science in India, and he prepared a review of a book by Coomaraswamy about Indian arts and artisans. The review, finally appearing in 1919, served to reprimand Western ignorance of Eastern civilizations –its "immense egoism." Indian art is situated at a pole removed from Western, individualistic art; but Indian crafts and decorative arts draw strength from the caste system, which keeps trades within families. Sarton drew lessons from Coomaraswamy, notably that a traditional genre of art contains the seeds of its own decline, for it has no strength to resist foreign corruption.[32] The war aborted Sarton's plans. Had it not intervened, it is possible that he would have devoted himself to Sanskrit and, perhaps, the art of South Asia, instead of to Arabic and Islamic science.[33] In London during July 1914, Sarton also visited the India Office, which "convinces me that the English bureaucracy is not worth more than that of the Continent." The Office received all Hindu publications, but the people there could not be bothered to unwrap them quickly. The most recent volumes unwrapped were from 1911.[34]

Writing to his wife in 1915, Sarton reiterated his attraction to things Oriental and his desire to try his fortune in

Japan after the war ends. He dreamed about training his daughter May in Japanese and Chinese and seeing her become curator in a museum.[35] Sarton pursued the possibility of moving to the Orient with his family. He wrote to Nicholas Murray Butler of the Carnegie Endowment for International Peace and also to Robert S. Woodward of the Carnegie Institution, asking for a mission to East Asia to complete a general history of science.[36] London ceramist Harold Stabler, a friend of Sarton's wife Mabel who introduced Sarton to the Oriental ceramics of the Victoria and Albert Museum, encouraged Sarton's plans, offering that China is "*the* place in the world."[37] In December 1915 Sarton asked Okuma Shigenobu, chancellor of Waseda University, about a trip to Japan.[38] He also enlisted the support of the former Belgian ambassador to China, E. de Cartier, for a position at the University of Peking, even though De Cartier advised against the initiative: The salaries were low, and life was both costly and dangerous.[39] As late as February 1918 Sarton considered traveling to Asia with his wife, a plan that the former Belgian ambassador to China continued to discourage.[40] But Mabel Sarton welcomed plans for him to travel East. If offered a post that "would not earn enough for me & [daughter] May to live on," he should "*take it the same*."[41] Sarton abandoned the plan when he obtained continuing support from the Carnegie Institution of Washington. He nevertheless spent increasing amounts of time in the great Northeastern art museums studying Asian painting and sculpture.[42] By October 1922, Sarton realized that he could not hope to write his *History of Asiatic Art* until he had completed his *Introduction to the History of Science*.[43] He wanted to edit, nevertheless, a counterpart to *Isis* dealing with Asian art.[44]

Around 7 July 1915 George outlined his plans for the future. He must survive, and then he must secure *Isis*. He indicated the study of Oriental science and three other writing projects: "Why I became a Buddhist, A Buddhist on the war, Buddhist art."[45] George had been absorbing Buddhism for several years, largely in art but also in the writings of Moncure Daniel Conway, the pacifist in London whose lectures at the South Place Ethical Society were attended by Sarton's wife Mabel and her family. Sarton obtained Conway's book, *My Pilgrimage to the Wise Men of the East* (Boston, 1906), soon after he married Mabel, and he credited the book with awakening his interest in things Oriental.[46] Buddhist thought, with its emphasis on self-denial and introspection, appealed to him even more when, as a war refugee, he experienced material deprivation and scholarly stasis. We also read an affinity with Paul Carus, editor of the periodicals *Open Court* and *Monist* and a devotee of Buddhism, who published George's early articles in the New World.[47]

When George Sarton started teaching at Harvard University in 1916, one of his first students was Yuen Ren Chao. Chao studied mathematics and philosophy at Cornell University and in 1914 was one of the organizers there of the influential journal *K'o Hseuh*, or *Science*, published in Shanghai, and with it the first scientific association in modern China, the Science Society.[48] Chao had already taken Lawrence J. Henderson's course in history of science, which consisted mainly in reading through John Theodore Merz's history of science in the nineteenth century, and he sought to make history of science one of his three fields for the doctorate.[49] Chao, who subsequently enjoyed a distinguished career at the University of California at Berkeley and at Tsinghua College in Beijing, became Sarton's first assistant.[50]

George Sarton depended on secondary works for his appreciation of science in Chinese history. As his introduction to the history of science reached the medieval period, he concludes in a sombre tone:

> My main hobby (the study of ancient Chinese paintings) has inspired to me the deepest admiration for the Chinese people and, if I am prejudiced, it is rather in their favor. But much as I love them, I am obliged to admit that they were great artists, that they showed considerable genius in practical affairs, for instance in the arts relative to printing or in husbandry, but that they were the weakest theoricians of all civilized peoples, ancient and modern. It is true that they did some very extraordinary work in mathematics, the formal nature of which appealed to them; their world-conceptions were not scientific in any sense, but an intolerable mixture of scholasticism and superstition.[51]

Science, for Sarton, is about generalizing and moving on to new questions. In his own writings, he continually tried to extract provisional conclusions—a synthetical inclination that brought only contempt from the great Orientalist Otto Neugebauer.[52] His characterization of science in China, which softened with the wisdom of age, might not be so far from the large distinction between the Mediterranean tradition of disputational theory and the East Asian tradition of irenic documentalism that attracted the eye of Nakayama Shigeru.[53]

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If George Sarton found his way to South Asia and East Asia through personal contacts, he acquired Arabic and a knowledge of Islamic civilizations by dint of private study and perseverance. His progress was slow and irregular. Arriving in Washington in 1915 as a refugee from Belgium, for example, he connected a past literary interest with a future scholarly focus on Arabic in the context of a technical invention. "While I was reading the *Arabian Nights* after

dinner, and while I was dreaming like one of [novelist] Francis Jammes' young creoles, I got at once the idea of a new kind of electric energy motor." (He drew up a prospectus, only to find that the motor had already been patented.)[54] Awaiting the birth of his third child in 1917, Sarton in New York writes to his wife in Cambridge that he is reading more of the *Arabian Nights* in the French translation of Joseph Charles Mardrus, "far superior to [Sir Richard Francis] Burton's translation."[55] During the late 1910s, Sarton pursued an ambitious project to edit Leonardo's manuscripts; the project dissolved as he devoted himself to learning Arabic and compiling notes for a universal history of science.[56] Early in September 1920, the Sartons vacationed at Pemaquid Point, Maine, near the family of the Arabist from the Theological Seminary in Hartford, Duncan Black Macdonald; Macdonald became George's first teacher of Arabic and a reviewer for *Isis*. Of his association with Sarton, Macdonald affirmed: "There is no part of my life as a scholar on which I look back with more satisfaction than this."[57]

As late as 1923 Sarton wrote that he has returned to studying Arabic by reading Sindbad the Sailor.[58] He emphasized in 1924: "Oriental, and chiefly...Muslim science...are the largest 'terrae incognitae' in our maps of the development of human progress."[59] Sarton's commitment to Arabic was sealed when he planed for a sabbatical year in 1925. He wondered if his family should visit Italy in the summer. It might not be good for his daughter May, who still did not know French well, and it might be better for him to work on Arabic than on Italian. "Italian is so easy that I can pick it up later in life. Arabic is so difficult that I must try to master it as promptly as possible." He asks if his wife would consider spending the summer in the foothills of the Atlas Mountains. For advice, he would write to geographer Emile Gautier, "the funny old professor at the University of Algiers, who dined once or twice at our home." The great attraction of Algeria was the Sahara. He recalled painter and novelist Eugène Fromentin's "enthusiastic & magnificent description of it," whether in his paintings or in his travel accounts.[60] Sarton's youthful *nom de plume*, which he used as late as 1912, is Dominique de Bray, borrowed from a novel of Fromentin's.[61]

Sarton writes in 1925: "Our failure to appreciate properly Muslim science, involves a failure to understand mediaeval science as a whole."[62] The fruit of Sarton's study of Arabic is apparent in the first volume of his *Introduction to the History of Science*, appearing in 1927.[63] The volume extends to the year 1000 (CE). It sets out Sarton's view that science should be studied on a world scale, where contributions from all disciplines are considered synchronically. In a global perspective, the years 750 to 1000 constitute a golden age for science in Islam; the last three-eighths of the text divides entirely into titles bearing the name of an Islamic savant. Although much space in this and succeeding volumes is devoted to short summaries of significant thinkers and to sources for examining their work in greater detail (the *Dictionary of Scientific Biography*, ably edited by Charles Coulston Gillispie and Frederic Lawrence Holmes, is this approach writ large), the volumes are distinguished by synthetic chapter introductions, which generally focus on fifty-year intervals in the history of Eurasia. By 1925 Sarton is still reading Arabic "extremely slowly," although his German colleagues Carl Schoy and Julius Ruska also did not read the language quickly.[64] In this race, the tortoises outstripped the hares.

Both the synthesis and the analytic summaries in the *Introduction to the History of Science* would have been impossible without *Isis*, whose name appears every few pages in the bibliographical notes. Sarton's journal was the research engine that powered his *Introduction*. The journal allowed him to receive review copies of significant monographs (and to benefit from expert appraisal of them), as well as to commission articles from international authorities. *Isis* placed Sarton in contact with thousands of scholars; he knew the name and specialties of nearly every significant historian of science active between 1920 and 1950. Since he cast his net wide, he came into contact, in addition, with a broad range of humanists and scientists. From his mature years at Harvard University, students remember Sarton as an isolated figure.[65] By 1940, however, Sarton was 56 years old, and he had been urged by his physician to moderate his labor.[66] He knew the world through his voluminous correspondence, inevitably organized around *Isis*.

A look through the first ten volumes of *Isis* reveal unusual interest in Islamic science, by 1925 Sarton's principal focus of interest.[67] Frequent contributors were Carl Schoy, Julius Ruska, Duncan Black Macdonald, Charles Homer Haskins, Max Meyerhof, Eric John Holmyard, and Giuseppe Gabrieli; Sarton himself provided reviews of articles and books by Eilhard Wiedemann, Heinrich Suter, Henry George Farmer, and Thomas Francis Carter, among many other scholars. Sarton, while respectful of French-language literature, kept French commentary on Islam at arm's length. Indeed, some French writers do not hold up well in the pages of *Isis*: Holmyard's devastating critique of Marcellin Berthelot's work in the history of medieval Islamic chemistry is matched by Ruska's rejection of Maurice Maeterlinck's imaginary spirit of Islamic civilization.[68]

Severe criticism of what Edward Said might identify as "Orientalist" thought is visible in the pages of *Isis*. In 1923, Julius Ruska excoriates Oswald Spengler's *Untergang des Abendlandes*, a book distinguishing the Apollonian-

Dionysian civilization of the Ancients and the Faustian civilization of the West from the "magical" civilization of Islam.[69] In his own writings, Ruska is wary about connecting a savant's environment with what appears from a savant's pen, although, in contrast to his judgment of Spengler, he nevertheless comments favorably on Carl Heinrich Becker's studies about Islamic civilization.[70] Sarton is more sympathetic to the life of savants than Ruska is, but Sarton also champions worldviews conceived beyond Europe. He quotes his faithful reviewer of South-Asian material, Paul Masson-Oursel:

> To us, the Orient teaches that our conceptual logic has a character that is exclusively European; that furthermore there has been the intelligible notion of intelligible relations other than the decomposition of a whole into its elementsBanalysisBor the composition of elements into a wholeBsynthesis; that there have been theories of reasoning not founded on theories of judgment, and theories of judgment not founded on theories of the concept.[71]

The editor of *Isis*, indeed, is remarkably sympathetic to Oriental philosophies, even philosophies that challenge the bases of experimental and mathematical science. He is enthusiastic about Rabindranath Tagore's translation of mystical poems by Kabir.[72] His comments on a journal devoted to Ayurvedic medicine might be nailed to the masthead of a postmodernist treatise: "The Ayurveda movement is a revolt not only against the intellectual domination of an alien race, but also against the highly artificial tendencies of our age, a return to simpler and more natural life, diet and therapy."[73] Simply put, Sarton's understanding of knowledge past is incompatible with the doctrines of an unreconstructed positivist, as his allegiance has mistakenly been identified.[74]

Sarton's sense of Oriental science is given general expression in an essay, "East and West," prepared as a Colver Lecture at Brown University in 1931, after he had worked through science in the early centuries of Islam. "The almost unbelievable vigor of the new culture may be well measured by the international triumph of the Arabic language," he observes. It was an ecumenical setting for science, where savants of nearly all creeds and origins worked toward a common purpose. Much of their activity concerned rehabilitating Greek texts, but "they did not simply transmit ancient knowledge, they created a new one." Sarton places the Islamic triumph in the context of his own time:

> The superiority of Muslim culture, say in the eleventh century, was so great that we can understand their intellectual pride. It is easy to imagine their doctors speaking of the western barbarians almost in the same spirit as our do of the "Orientals." If there had been some ferocious eugenists among the Muslims they might have suggested some means of breeding out all the western Christians and the Greeks because of their hopeless backwardness.

Sarton imagines that those among his contemporaries who condemn the East and lionize the West are lacking in an understanding of science, for in science Islam revealed its strength. He concludes:

> The scientist who is not too proud, who does not assume an aggressively "Western" attitude, but remembers the eastern origin of his highest thoughts, who is not ashamed of his ideas—will be more efficient, he will be a more humane, a better servant of the truth, a better instrument of destiny, a gentler man.[75]

Sarton is a balanced commentator on Islamic civilization, notably with regard to religious fundamentalism in it. He is a stern critic of scholasticism, an appeal on the basis of faith rather than reason to canonical texts, which he identifies at the root of medieval thought in many civilizations: "We can witness the desperate efforts of a large number of Muslim, Jewish, and Christian schoolmen to reconcile Hellenic rationalism with three different sets of religious dogmas. What is most extraordinary is that they all succeeded in doing this to their satisfaction." In his view, progress depends particularly upon the emancipation of science from religion, an emancipation accomplished after the sixteenth century much more effectively in Western Europe than in Eastern civilizations.[76]

Some of Sarton's correspondents were circumspect about Islamic cultures. Max Meyerhof, a practising opthamalogist in Cairo, was inelegant about the commitment of Egyptians to purchasing a volume of Sarton's: "There is the thing which disgusted so much my dear friend [Henri] Grégoire, that Orientals nearly never keep their promises and engagements; it is possible to deal with them only in handling them like children!"[77] (In 1926 Grégoire became dean of the Faculty of Letters at the renovated Egyptian University in Cairo.[78]) Meyerhof, facing Nazi criminality, dwelt on brigandage in Palestine: "The Turks eradicated these bad habits by freely hanging, the only effective treatment of three thousand year old robbery-instincts."[79] Generally Meyerhof saw the matter in terms of practical needs. He wrote in English in 1922: "The Egyptians themselves as most of the young nations do not show much interest for the scientific history of their own ancestors, as far as it does not satisfy their national prand [*sic*]. Nevertheless I hope that the new spirit will come more and more!"[80]

There can be no doubt, nevertheless, that Sarton's circle was tolerant of Mediterranean and Asian civilizations in a way that escaped other academic writers of the time, from social darwinians and eugenicists to a wide range of anthropologists. In fact, from the very beginning of his periodical *Isis*, Sarton was unable to attract patrons and

contributors troubled by his ecumenical orientation.[81] We obtain a clear sense of Sartonian equanimity in a letter in English from Meyerhof to Sarton, where Meyerhof contrasts backward Germany to progressive Egypt:

> I have been elected as a member of the Institut d'Egypte and will try to help to the awakening of this sleeping 'academy'. On the other hand, [Karl] Sudhoff asked me wether I was envious to accept the Leipzig professorship for History of Medicine in the case [Henry] Sigerist would accept the nomination to the Johns Hopkins chair which had been offered to him. The hope to be entitled to a pension in case of incapacity to work would be the attraction of such an offer, besides the wonderful Leipzig Institute and Library. But the actual state of things in Germany and the prevalence of intolerance and racial nationalism in German universities would alone prevent me from accepting the offer. After the free field of international relations here I could not live behind the barbed wire of stupid prejudice.[82]

And Meyerhof was not alone among Sarton's correspondents in rejecting nationalism. George Sarton's faithful reviewer and correspondent Paul Masson-Oursel observed about a work on Hindu physics by the Indian nationalist Kishori Lal Sirkar:

> It is the exposition of atomistic physics implied in one of the 6 orthodox systems: Vaisesika. The fault seems to me to consist with most natives who have a nodding acquaintance with European science, be it only with its most elementary vocabulary, for on a whim they claim to find in their very old texts the essential parts of European ideas. In this way, they risk understanding neither our science nor their own past.[83]

Edward Said represents Masson-Oursel as an imperialist exploiter of the Orient, but in fact Masson-Oursel was a syncretist who wrote enthusiastically upon the foundation of *Isis* that Sarton's orientation fit well with his own training under Emile Durkheim and Gaston Milhaud and his own fervor for comparative philosophy in the service of historical synthesis.[84] Equanimity extends to Duncan Black Macdonald, identified by Edward Said as a mean Orientalist ignorant of the achievements of Islamic science, who knows how to "discount" the prejudices in an anthropological commentary on Arab life.[85] And consider the influential scholar Sir Hamilton Alexander Roskeen Gibb, whom Said represents as a systematic denigrator of Islamic civilizations. Gibb writes to George Sarton in 1947:

> You are in many respects more in touch with men & ideas on the Continent of Europe than we are, but I am sometimes disturbed by the lack of any sense of urgency amongst people here. Perhaps they are right & there is no urgency, but I cant help feeling that we should be doing more than we are doing to rebuild & [reform?] the cultural life of Europe. Or are we obsessed by the thought that for every bridge we try to build the scientists are preparing to blow up a thousand?
>
> I don't really think so. The trouble seems rather to be that no real or close association is quite painless, & every one on every side shrinks from the sacrifices it demands—not the material ones if there are any, but the spiritual ones, the breaking down of our isolations or self-sufficiencies. We want to show the world that 'British' or 'American' or 'French,' or science, or learning, or art or what-not still stands at the top of the list. And the governments are doing their best to hinder mutual help by restrictions on the transfer of books & every form of international intercourse.
>
> But I am becoming violent or bitter and I have least excuse of anybody for bitterness. No memories could be happier than those of the friendly meetings & talks that I enjoyed during these recent visits to America, & my relations with all our French or other European colleagues are extremely cordial—You by just being where you are in Harvard & maintaining your network of correspondence are doing as much as any man, I think, to keep us all together. If ever there were an honorary citizenship of the world, you should be citizen no. 1! And what could not Oxford & Harvard & Paris do to make a common citizenship in letters at least, a reality.[86]

The condescension of a don, certainly, but an expression of ecumenism is unmistakable at precisely the time when, in some parts of the Islamic world, ecumenism was in short supply.

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* *

George Sarton recognized early in 1920 that his "exhaustive" project (the description is Joseph Needham's)[87] required his permanent installation in Harvard's new Widener Library. Located with his family in miserable accommodations in Washington, just having returned from four months of travel in Europe, Sarton wrote: "I am dreaming of going back to Cambridge; this seems to me now to be [the] only place in this country where there is a sufficient depth & a sufficient density of culture to make life bearable."[88] He persuaded his employer, the Carnegie Institution of Washington, of the scheme, and his patron Lawrence J. Henderson at Harvard arranged for him to be appointed lecturer at no salary, giving "a few lectures in the course of the year in payment for the use of a room in the library."[89] Sarton explained his flight from Washington in a letter to Antonio Favaro. In addition to difficulties with continuing *Isis*, "the

intellectual atmosphere of Washington does not please me: Life is too political, too bureaucratic, with too much wealth and too little culture." He will move to Cambridge, "the most civilized city in America."[90] Sarton came to resent his marginal status at Harvard (eventually regularized by a professorship), but Widener received only his laudation.[91]

When Joseph Needham conceived his own narrative account of science and civilization in China, he was the Sir William Dunn Reader in Biochemistry at the University of Cambridge, although by the time that his first volume appeared in 1954 he had become Master of Gonville and Caius College. Cambridge, the ranking scientific university of England, was the appropriate setting for his undertaking. In launching his work, Needham (generous by nature), begged Sarton's indulgence:

> His great and indispensable work will always fulfil the role of a mine of suggestions for research, as well as of an encyclopaedia of information; and it is to be hoped that no one would feel (as I am sure that he himself would not) that so great an achievement would render unnecessary the elaboration of monographs such as the present one.[92]

Sarton figures throughout the early volumes as an authority, both for his historical discoveries and his interpretations.

Among scholars in the middle of the twentieth century, it would be hard to find a thinker more independent than Joseph Needham. He was sympathetic to religion while remaining a firm defender of the Soviet Union. Holder of high office in London and Cambridge, he was generous about crediting remotely-situated colleagues. Just as George Sarton does not receive good press today, it has become fashionable to discredit Needham's view of history of science, in which different civilizations retain the honor of discoveries while nevertheless privileging the formulation of scientific method in Western Europe.[93] Yet at the present time, when competing social groups seek to exterminate rivals with depressing regularity, it is refreshing to revisit the ecumenism of Joseph Needham and George Sarton, which found expression in the search for a master narrative about science.

I suspect that, notwithstanding his condemnation of canonical interpretations of history, Edward Said would not have found Needham and Sarton unsympathetic. Said concluded *Orientalism* with a Sartonian plea:

> If we remember that the study of human experience usually has an ethical, to say nothing of a political, consequence in either the best or worst sense, we will not be indifferent to what we do as scholars. And what better norm for the scholar than human freedom and knowledge? Perhaps too we should remember that the study of man in society is based on concrete human history and experience, not on donnish abstractions, or on obscure laws or arbitrary systems.[94]

Great Marxist scholars of the last century like Needham, Dirk Struik, and Antonie Pannekoek certainly were not shy about engaging in politics, but who among historians of science was more passionate about freedom and knowledge than social-democrat George Sarton?

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* *

Edward Said's thesis that knowledge about the world is segregated according to the culture of the knower finds a counterpart in the postmodernist contention that modern science is nothing more than local knowledge; postmodernist historians of science share the indifference of Sherlock Holmes and Dante Gabriel Rossetti about whether the earth lies at the center of the universe. Professions of the postmodernist faith that knowledge is a relativist, social construction are still commonplace. A prominent geographer at the University of Edinburgh, Charles W. J. Withers, affirms that maps do not mirror reality so much as they reveal their makers: "Maps do not reflect what there is so much as they reflect the concerns of their makers." Notwithstanding his rhetorical plea for contextualizing cartography, however, Withers does not deny that there is a truth, for example, to the course of the Niger River in Africa—and that the place of the river may be known with certainty from accurate maps.[95] In a recent survey of cultural imperialism, sociologist Bernd Hamm, who is Jean Monnet Professor of European Studies and UNESCO Chair in Europe in a Global Perspective at the University of Trier, contends that science is a doctrine serving to keep the world in chains:

> Western concepts of science and truth are used to legitimate interests aimed at the suppression and exploitation of nature and humans. They are used to mask the destructive character of Western political-economic interests. In doing this, science and truth have become ideologies. As such, they tend to benefit the 'Power Elites' (C.W. Mills 1956) of society and, of course, the scientific community, at the cost of the population at large. The forced global imposition of this understanding of science and truth is part of cultural imperialism.

Hamm proposes that science is just one of many codes for acquiring knowledge, and "irrelevant as this code might be for the majority of ordinary people, it has still succeeded in gaining strategic influence among cadres."[96] But Hamm is a soft-core critic of science, for he does not maintain that scientific medicine is as effective in curing disease as voodoo, that Maxwell's equations are no more certain guides to nature than the residues of tea leaves are, and that polymers can be

synthesized as effectively through prayer as by way of chemistry.

Reading Withers's and Hamm's work, I sense a defensiveness that was absent a decade ago among writers sympathetic to postmodernist doctrine. If their writing is a guide, then there has been a generally favorable reception to recent surveys about imperialism and world-wide science emphasizing the essential unity of certain learned disciplines—geology, and astronomy, and history—in the modern period.[97] That is to say, evidence reveals categories of analysis that transcend the particular setting of someone who engages them; people everywhere, in sum, may discover regularities of nature.

In a rebuke of postmodernist relativists that may also caution uncritical admirers of Edward Said's writings, Michael Hardt and Antonio Negri—writers who are stern critics of Western domination—emphasize:

> The postmodernist epistemological challenge to 'the Enlightenment'—its attack on master narratives and its critique of truth—…loses its liberatory aura when transposed outside the elite intellectual strata of Europe and North America. Consider, for example, the mandate of the Truth Commission formed at the end of the civil war in El Salvador, or the similar institutions that have been established in the post-dictatorial and post-authoritarian regimes of Latin America and South Africa. In the context of state terror and mystification, clinging to the primacy of the concept of truth can be a powerful and necessary form of resistance. Establishing and making public the truth of the recent past—attributing responsibility to state officials for specific acts and in some cases exacting retribution—appears here as the ineluctable precondition for any democratic future. The master narratives of the Enlightenment do not seem particularly repressive here, and the concept of truth is not fluid or unstable—on the contrary![98]

It is possible to connect this view with the thought of Noam Chomsky, a linguist whose consistent and reasoned criticism of imperialism is a matter of record. Chomsky writes:

> Many scientists, not too long ago, took an active part in the lively working class culture of the day, seeking to compensate for the class character of the cultural institutions through programs of workers' education, or by writing books on mathematics, science, and other topics for the general public. Nor have left intellectuals been alone in such work, by any means. It strikes me as remarkable that their left counterparts today should seek to deprive oppressed people not only of the joys of understanding and insight, but also of tools of emancipation, informing us that the "project of the Enlightenment" is dead, that we must abandon the "illusions" of science and rationality—a message that will gladden the hearts of the powerful, delighted to monopolize these instruments for their own use.[99]

Noam Chomsky writes as the social conscience of modern science. In its veneration of utility, however, the Enlightenment contains the seeds of both the prosecution and the erosion of science. In the decade since Chomsky wrote the foregoing lines, science has increasingly become driven by technological imperatives. Although abstract, speculative endeavors in the past have often been sustained only with great difficulty, today *science*—as the word has been understood over the past two centuries—is threatened with eclipse by demands for pecuniary gain.[100] If the coming period in the West turns out to resemble the Roman or the Ottoman empire, followers of Edward Said might anticipate witnessing the attenuation of active, dispassionate investigation into the regularities of the natural world.

That would belong to the past. The future is captured in a recent observation by the British historian of design Lanto Synge, who sees signs that "A new style, neither brutal nor twee, will help restore self-confidence and interest in the wake of 'post-modernism.'"[101] It is a future outlined a generation ago by critic George Steiner, whose thoughts appeared at the beginning of my story. Steiner, at the end of his essay *In Bluebeard's Castle*, reconsiders Max Horkheimer and Theodor W. Adorno's contention, in their *Dialektik der Aufklärung*, that "the old obscurantisms of religious dogma and social caste have been replaced by the even more tyrannical obscurantism of 'rational, scientific truth.'" Nowhere do Horkheimer and Adorno provide a template "for a mode of human perception freed from the 'fetishism of abstract truth.'" In Steiner's view, "The pursuit of the facts, of which the sciences merely provide the most visible, organized instance, is no contingent error embarked on by Western man at some moment of élitist or bourgeois rapacity." Rather, it is hardwired into the human brain, in the manner of Chomsky's fundamental syntax. Steiner, the polyglot reader of comparative literature, is uncertain where reason shall lead, but he is unambiguous about the importance of history of science in forging the path forward: "The absence of the history of science and technology from the school syllabus is a scandal." He is clear, too, about the centrality of the author of *Science and Civilization in China*. For Steiner, "Proust's only successor is Joseph Needham."[102] Can it not be, then, that the new style intimated by Lanto Synge is the one informed by Needham's enlightened prose and the comparative spirit? However we understand culture over the coming years, the understanding will be informed by direct contact with the thought of peoples located at all points of the compass. That we know each other's meaning, even if incompletely and imperfectly, vindicates the

enterprise of the ecumenical historians of science in George Sarton’s orbit during the early twentieth-century Golden Age of learning.

Notes

1. George Steiner, *In Bluebeard's Castle: Some Notes towards the Redefinition of Culture* (New Haven, 1971), pp. 3-4, 7.

2. Walter Benjamin, "Theses on the Philosophy of History," in *Illuminations*, trans. Harry Zohn (New York, 1968), pp. 259-60 (Thesis IX). It is an image that Benjamin elaborated in the 1930s, as Hannah Arendt observes in the book's introduction. Benjamin introduces the thesis with a quatrain by Gerhard Scholem. Zohn's translation of Scholem's poem makes no sense to me, providing "timeless time" for Alebendige Zeit." I prefer: "My wing is ready to soar,/I would rather turn back,/If I stayed with unfolding time,/ I would have little luck." Marion Kintzinger, "Der Engel der Geschichte: Gestaltungsformen historischen Denkens in der frühen Neuzeit und bei Walter Benjamin," *Archiv für Kulturgeschichte, 81* (1999), 149-72, for a comprehensive survey of writing about Benjamin's angel; Philippe Fleury, "L'Ange comme figure messianique dans la philosophie d'histoire de Walter Benjamin," *Archives de sciences sociales des religions, 78* (1992), 169-77, for a discussion of Benjamin's sources and inspiration; O. K. Werckmeister, "Walter Benjamin, Paul Klee, and the Angel of History," *Oppositions, 25* (1982), 102-25, for the evolution of Benjamin's ideas about history and destruction. Benjamin's angel has been enlisted to serve many masters. Judith Perkins, "The Angel of History," *Classical World, 96* (2003), 421-6, for the angel as a harbinger of postmodern relativism. I elaborate in a forthcoming publication, "Forward into the Past."

3. Jürgen Habermas, *The Philosophical Discourse of Modernity*, trans. Frederick G. Lawrence (Cambridge, Mass., 1990), pp. 14-15 for the analysis of Walter Benjamin.

4. Steiner, *Bluebeard's Castle*, pp. 8, 133-5. It is possible that Steiner's entirely optimistic vision of the history of science is due in part to conversations with his Yale University colleague Derek J. de Solla Price, a promoter of the humanities of science and a founder of the field of scientometrics.

5. Gunther Stent, *The Coming of the Golden Age: A View of the End of Progress* (Garden City, N.Y., 1969). The work has been popularized by John Horgan in his claim that science has gone as far as it can go: *The End of Science: Facing the Limits of Knowledge in the Twilight of the Scientific Age* (Reading, Mass., 1996), pp. 9-16.

6. John Ralston Saul, *Voltaire's Bastards: The Dictatorship of Reason in the West* (New York, 1993), pp. 584-5; Václav Havel, *Disturbing the Peace: A conversation with Karel Hví)□ala*, trans. Paul Wilson (New York, 1991), pp. 13-15.

7. For many years I had in my office a collection of about 12,000 German doctoral dissertations from the years 1895-1925; in the 1990s, the bulk of the collection went to the library of Université de Montréal. Acquired by the University of Pennsylvania through exchange agreements, the dissertations spanned all faculties and most German-language universities; following their deaccession, the dissertations were given to me by librarian Rudolf Hirsch. Lewis Pyenson, "The Liberation of Higher Learning," Council of Graduate Schools (Washington), *Communicator, 21*, no. 4 (1998), 1-4; Lewis Pyenson and Douglas Skopp, "Educating Physicists in Germany *circa* 1900," *Social Studies of Science, 7* (1977), 329-66.

8. Arnold J. Toynbee, *A Study of History, Volume 9* (London, 1954), pp. 705-17.

9. Ryan Dunch, "Beyond Cultural Imperialism: Cultural Theory, Christian Missions, and Global Modernity," *History and Theory, 41* (2002), 301-25, on pp. 318, 324.

10. Lewis Pyenson, “Science in History: A Global Perspective,” in *Science, Technology, and Society*, ed. Sal Restivo, (New York, in press).

11. Thucydides, *History of the Peloponnesian War*, trans. Rex Warner (1954; New York, 1972), p. 147.

12. Edward Said, *Orientalism* (1978; New York, 1994).

13. Michael Hardt and Antonio Negri, *Empire* (Cambridge, Mass., 2000), p. 125.

14. Said, *Orientalism*, pp. 261, 263.

15.Lewis Pyenson and Susan Sheets-Pyenson, *Servants of Nature: A History of Scientific Institutions, Enterprises, and Sensibilities* (London, 1999), p. 438.

16. Lewis Pyenson, “Prerogatives of European Intellect: Historians of Science and the Promotion of Western Civilization,” *History of Science, 31* (1993), 289-315; “The Ideology of Western Rationality: History of Science and the European Civilizing Mission,” *Science and Education, 2* (1993), 329-43.

17 .Lewis Pyenson, *Civilizing Mission: Exact Sciences and French Overseas Expansion, 1830-1940* (Baltimore, 1993), pp. 312-13.

18. Lewis Pyenson, “Assimilation and Innovation in Indonesian Science,” *Osiris, 13* (1998), 34-47.

19. The extent of their scholarship is revealed in François Charrette”s remarkable thesis, *Orientalisme et histoire des sciences: l’historiographie européenne des sciences islamiques et hindoues, 1784-1900* (MSc thesis, Université de Montréal, 1995).

20. There is a large literature commenting on Edward Said’s *Orientalism*. Noteworthy are Keith Windschuttle’s analysis of Said’s use of British novels, “Cultural History and Western Imperialism: The Case of Edward Said,” *Journal of the Historical Society, 1*, nos 2/3 (2000), 169-206; Peter Heehs, “Shades of Orientalism: Paradoxes and Problems in Indian Historiography,” *History and Theory, 42* (2003), 169-95, pp. 170-2 for criticism of Said and a taxonomy of scholarship about South Asia; and John M. MacKenzie, *Orientalism: History, Theory and the Arts* (Manchester, 1995).

21. George Sarton Papers: bMS Am 1803.1 (letters by George Sarton), bMS Am 1803.2 (letters to George Sarton), Houghton Library of Harvard College Library, Cambridge, MA [henceforth HGS], Max Meyerhof to George Sarton, 23 September 1927.

22. Thomas F. Glick, “From the Sarton Papers: Paul Kraus and Arabic Alchemy,” *Cronos, 2* (1999), 221-44, on p. 240.

23. Mansel Davies, “Joseph Needham (1900-95),” *British Journal for the History of Science, 30* (1997), 95-100.

24. HGS, Joseph Needham to George Sarton, 27 September 1954.

25. The issues are treated in my forthcoming book, *The Passion of George Sarton: A Modern Marriage and Its Discipline*.

26. Charles Holme, “Japanese Flower Painting,” *The Studio*, 15 April 1904; G. S., “O’Kama d’Osaka,” *Almanach de l’Université de Gand* [Société générale (fédération) des Etudiants libéraux], 1904, pp. 378-9.

27. George Sarton, "Why *Isis*?" *Isis, 44* (1953), 232-42, on p. 235 for the Japanese exhibition, Fox Strangways, and Coomaraswamy. James S. Crouch, *A Bibliography of Ananda Kentish Coomaraswamy* (New Delhi, 2002), for commentary on Coomaraswamy's enormous *oeuvre;* Roger Lipsey, *Coomaraswamy: His Life and Work* (Princeton, 1977), p. 91 for the India Society and the musical connection. Coomaraswamy was the son of a Tamil father and English mother; he was the first director of the Geological Survey of Ceylon. By the eve of the First World War, he had become an Indian nationalist and his interest turned toward Indian philosophy and art, which he collected. "A. H. Fox Strangways," *Music and Letters, 29* (1948), 229-37, for a number of appreciations in the journal that he founded. On Shepherd's Bush: Ayako Hotta-Lister, *The Japan-British Exhibition of 1910: Gateway to the Island Empire of the East* (Richmond, Surrey, 1999).

28. George Sarton's diaries: MS Am 2117, *60M-177. Houghton Library of the Harvard College Library, Cambridge, MA [henceforth Diary], 1 September 1911.

29. HGS, David Eugene Smith to George Sarton, 25 October 1912. Probably Smith means Seki Takakazu, a key figure in the formulation of the Japanese style of mathematics known as *wasan*. Seki and *wasan* are treated by Smith in *A History of Japanese Mathematics* (Chicago, 1914). Smith's close colleague was Mikami Yoshio, also later a correspondent of Sarton's.

30 .HGS, David Eugene Smith to George Sarton, 14 November 1912.

31. HGS, Paul Masson-Oursel to George Sarton, 4 January 1913 and 23 January 1913.

32. George Sarton, "Ananda K. Coomaraswamy, *The Arts and Crafts of India and Ceylon*," *Isis, 2* (1919), 404-7.

33. George Sarton, "Why *Isis*?" *Isis, 44* (1953), 232-42, on p. 242.

34. George Sarton to Mabel Sarton, 10 June 1915, Correspondence between George Sarton and Eleanor Mabel Sarton, The Berg Collection of English and American Literature, The New York Public Library, Astor, Lenox and Tilden Foundations, New York, George Sarton to Mabel Sarton, 14 July 1914. Subsequent letters between George and Mabel Sarton come from the New York Public Library.

35. George Sarton to Mabel Sarton, 10 June 1915.

36. Diary, 6 October 1915; Archives of the Carnegie Institution of Washington, Washington, DC, George Sarton to Robert S. Woodward, 6 October 1915.

37. HGS, Harold Stabler to George Sarton, 29 April 1915. Sarton recalls the tour of Oriental ceramics on 7 March 1915 in a memorandum located in the George Sarton papers, consulted at the residence of May Sarton, York, Maine. Since 1997 the material has been dispersed, much of it to the Berg Collection at the New York Public Library.

38. Diary, 3 December 1915.

39. HGS, E. de Cartier to George Sarton, 23 December 1915 and 11 May 1916.

40. Mabel Sarton to George Sarton, February 1918.

41. Mabel Sarton to George Sarton, received on 18 February 1918.

42. George Sarton, "Matériaux pour l'histoire de l'art asiatique (première série)," *Gazette des beaux-arts, 8* (1923), 1-17; George Sarton, "Art as an Approach to Asia," *Yale Review, 15* (1926), 540-52, on pp. 540, 551-2.

43. Diary, 1 October 1922.

44. George Sarton, "Why Isis?" *Isis, 44* (1953), 232-42, on p. 236.

45 .Located in the Papers of May Sarton, Series XV Family Papers 1846-1993, Boxes 171-182, The Berg Collection of English and American Literature, The New York Public Library, Astor, Lenox and Tilden Foundations, New York [henceforth NYPL].

46. George Sarton, "Adventures of a Scholar's Wife," notes for a biography of Mabel Elwes Sarton, in NYPL. In 1914 George notes a biography of Conway, "the general thinker and noble pilgrim." George Sarton, "John M. Robertson, *The Life Pilgrimage of Moncure Daniel Conway*," *Isis, 2* (1919), 450.

47. George Sarton, "The Future of Belgium," *Open Court, 29* (1915), 257-72; George Sarton, "The History of Science," *Monist, 26* (1916), 321-63. The *Open Court* article was a collaboration with Mabel Sarton. Pyenson, *Passion of George Sarton*.

48. Yuen Ren Chao, *Life with Chaos: The Autobiography of a Chinese Family, 2: Yuen Ren Chao's Autobiography, First 30 Years, 1892-1921* (Ithaca, 1975), pp. 79, 84. Zuoyue Wang, "Saving China through Science: The Science Society of China, Scientific Nationalism, and Civil Society in Republican China," *Osiris, 17* (2002), 291-322, on p. 304. In Pinyin, Chao's name is given as Zhao Yuanren.

49. HGS, Yuen Ren Chao to George Sarton, 30 June 1916.

50. George Sarton to Mabel Sarton, 8 March 1925, for recruiting a successor to Chao. George Sarton, *Introduction to the History of Science, Volume 1: From Homer to Omar Khayyam* (Baltimore, 1927), p. 48, for Chao's earlier labor as an assistant.

51. George Sarton, "Alfred Forke, *The World-Conception of the Chinese*," *Isis, 7* (1925), 373-5.

52 .Lewis Pyenson, "Inventory as a Route to Understanding: Sarton, Neugebauer, and Sources," *History of Science, 33* (1995), 253-82, on pp. 274, 282 (note 106).

53. Shigeru Nakayama, *Academic and Scientific Tradition in China, Japan, and the West*, trans. Jerry Dusenbery (Tokyo, 1984), pp. 3-16.

54. George Sarton to Mabel Sarton, 26 and 27 April 1915. George drew up a prospectus on 25 April 1915, corrected it on 27 April. YMS, for the correction on 27 April 1915.

55. George Sarton to Mabel Sarton, 27 July 1917.

56. As he describes in George Sarton, *Six Wings: Men of Science in the Renaissance* (Bloomington, 1957), p. 306. Francis Jammes, a French Catholic novelist, was one of young George Sarton's favorite writers.

57. As Sarton relates in *Introduction to the History of Science, Volume I*, p. 45, and "Why *Isis*?" *Isis, 44* (1953), 232-42, on p. 237. Sarton has Macdonald vet his comments on publishing Arabic words in the Roman alphabet. George Sarton, "Note on the Transliteration of Arabic," *Isis, 6* (1924), 410-12, on p. 412. Macdonald in William Douglas Mackenzie, "Duncan Black Macdonald, Scholar, Teacher, and Author," in *The Macdonald Presentation Volume*, ed. Robbins Wolcott Barstow (Princeton, 1933), pp. 1-9, on p. 6. Thomas F. Glick, trans. Mercè Viladrich, *George Sarton i la història de la ciència a Espanya* (Barcelona, 1990), p. 19.

58. George Sarton to Mabel Sarton, 5 August 1923.

59. George Sarton, “Introduction to the History and Philosophy of Science,” *Isis, 6* (1924), 543-6, on p. 546.

60. George Sarton to Mabel Sarton, 25 January 1925. Emile Gautier was a stern critic of the notion of African cultural clusters developed by German ethnologist Leo Frobenius. George Sarton, *Isis, 4* (1921-22), 623.

61. Dominique de Bray, pseud. George Sarton, “Romain Rolland et Malwida von Meysenbug,” *Flamberge,* no. 11 (1913), 503-9, Sarton’s article dated November 1912. The issue is devoted to Romain Rolland. A copy of this issue is available in the Bibliothèque Nationale de France (Tolbiac, Rez-de-jardin), Paris. For Rolland’s reaction: Romain Rolland to Jean-Richard Bloch, 17 December 1913, in *Deux hommes se rencontrent: Correspondance entre Jean-Richard Bloch et Romain Rolland (1910-1918),* ed. Mme Jean-Richard Bloch and Mme Romain Rolland [Cahiers Romain Rolland, 15] (Paris, 1964), p. 223. Marie-Brunette Spire kindly alerted me to this passage.

62. George Sarton, reviewing E. J. Holmyard’s edition of a work by Abu=l-Qâsim Muhammmad ibn Ahmad al->Irâqî, in *Isis, 7* (1925), 124-8.

63. George Sarton, *Introduction to the History of Science, Volume 1*.

64. HGS, Heinrich Wieleitner to George Sarton, 9 February 1925, for the quotation from a letter of Sarton’s and for the comparison with German colleagues. Max Meyerhof to George Sarton, 6 November 1931, where Meyerhof comments that he and Joseph Schacht “have to call for the help of a specialist in poetry” in Arabic.

65. Henry Guerlac (who took a doctorate at Harvard University and knew Sarton there), comments that Sarton’s “contacts...with Harvard scientists seem to have been virtually non-existent.” Guerlac, “Sartoniana and Forward,” *Lychnos*, 1986, pp. 1-27, on p. 9. Sarton’s doctoral student I. Bernard Cohen recalls: “Sarton was a lonely man. He had no colleagues at Harvard, very few close intellectual friends.” I. Bernard Cohen, “Introduction: The Impact of the Merton Thesis,” in *Puritanism and the Rise of Modern Science: The Merton Thesis*, ed. Cohen (New Brunswick, N.J., 1990), pp. 1-111, on p. 26.

66. NYPL, Mabel Sarton to Marthe Patyn, 15 December 1935, in French, where Mabel observes that George is sometimes tired. “He follows the advice of the doctor carefully since the *accroc* he had 3 years ago.”

67. George Sarton to Mabel Sarton, 15 March 1925, where he comments that he is revising the Greek material in the first part of his *Introduction,* which he has completed.

68. E. L. Holmyard, “A Critical Examination of Berthelot’s Work upon Arabic Chemistry,” *Isis, 6* (1924), 479-99, p. 485: “I feel that it is quite unsafe to accept any of his conclusions without first referring to the original sources or without strong collateral evidence.” Julius Ruska, “Maurice Maeterlinck, *Das grosse Rätsel* [German translation],” *Isis, 7* (1925), 167-8.

69. Julius Ruska, “Oswald Spengler, *Der Untergang des Abendlandes*,” *Isis, 5* (1923), 176-81. HGS, Julius Ruska to George Sarton, 31 January 1921, for Spengler’s “often fanciful assertions.”

70. Ruska’s general strictures in his review of Carl Heinrich Becker’s *Islamstudien,* in *Isis, 6* (1924), 559-61, a book that he finds appealing and useful.

71. George Sarton, “Paul Masson-Oursel, *La Philosophie comparée*,” *Isis, 6* (1924), 99-104, on p. 103.

72. George Sarton, “Kabir, *One Hundred Poems*,” *Isis, 3* (1920-21), 101.

73. George Sarton, “*Journal of Ayurveda*,” *Isis, 9* (1927-28), 555.

74. Tore Frängsmyr, “Science or History: George Sarton and the Positivist Tradition in the History of Science,” *Lychnos*, 1973/74, pp. 104-44.

75. George Sarton, “East and West,” in *The History of Science and the New Humanism* (New York, 1956), pp. 59-110, quotations on pp. 86, 89, 110.

76. Sarton, *Introduction to the History of Science, Volume 1*, pp. 27-9.

77. HGS, Max Meyerhof to George Sarton, 26 June 1931.

78. HGS, Max Meyerhof to George Sarton, 17 August 1926.

79 .HGS, Max Meyerhof to George Sarton, received 21 January 1937.

80 .HGS, Max Meyerhof to George Sarton, 5 September 1922.

81. The Ghent mathematician and historian of mathematics Paul Mansion as well as the French polymath Pierre Duhem both declined Sarton’s invitation to sit on the first editorial board of *Isis;* they cited differences in approaching scholarship. HGS, Pierre Duhem to George Sarton, 11 April 1912, printed in George Sarton, “Acta atque Agenda,” *Archives internationales d=histoire des sciences, 4* (1951), 323-56, p. 354. HGS, Paul Mansion to George Sarton, 12 February 1912. Sarton reflected a lifetime later that Mansion, a devout Catholic, may have associated the word Isis with Freemasonry—Mansion would have known about George’s Freemason father and also about Sarton’s socialist activity. George Sarton, “Why Isis?” *Isis, 44* (1953), 232-42.

82. HGS, Max Meyerhof to George Sarton, 18 February 1932.

83. HGS, Paul Masson-Oursel to George Sarton, 15 January 1915. Kishori Lal Sirkar, *An Introduction to the Hindu System of Physics, being an exposition of Kanad-Sutras relating to the subject* (Calcutta, 1911).

84.HGS. Paul Masson-Oursel to George Sarton, 15 January 1015. Kishori Lal Sirkar, *An Introduction to the Hindu System of Physics, being an exposition of Kanad-Sutras relating to the subject* (Calcutta, 1911).

85.Duncan Black Macdonald, “Adela Goodrich-Freer, *Arabs in Tent and Town*,” Isis, 7 (1925, 572; Said, *Orientalism*, pp. 247, 276-7.

86. NYPL, Box 177, Mabel Sarton, copybook dated Ipswich, July 1932: H. A. R. Gibb to George Sarton, 2 June 1947.

87 .Joseph Needham, with the research assistance of Wang Ling, *Science and Civilization in China, Volume 1*: *Introductory Orientations* (Cambridge, 1954), p. 7.

88. Diary, 3 February 1920.

89. HGS, Lawrence J. Henderson to George Sarton, 9 February 1920.

90. HGS, George Sarton to Antonio Favaro, 16 March 1920, draft in Italian.

91 .Pyenson, “Inventory as a Route to Understanding,” p. 263.

92. Needham, *Science and Civilization in China, Volume 1*, p. 42.

93. Francesca Bray, “Technics and Civilization in Late Imperial China,” *Osiris, 13* (1998), 11-33, on p. 14.

94. Said, *Orientalism*, pp. 327-8.

95. Charles W. J. Withers, “History and Philosophy of Geography, 2002-2003: Geography in Its Place,” *Progress in Human Geography, 29* (2005), 64-72, quotation on p. 67; Withers, “Mapping the Niger, 1798-1832: Trust, Testimony and ‘Ocular Demonstration’ in the Late Enlightenment,” *Imago Mundi, 56* (2004), 170-93.

96. Bernd Hamm, “Cynical Science: Science and Truth as Cultural Imperialism,” in *Cultural Imperialism: Essays on the Political Economy of Cultural Domination*, ed. Bernd Hamm and Russell Smandych (Peterborough, Ont., 2005), pp. 60-76, on pp. 60-1.

97. Evan Schofer, “The Global Institutionalization of Geological Science, 1800-1990,” *American Sociological Review, 68* (2003), 730-59; Willem Wamsteker, Rudolf Albrecht, and Hans J. Haubold, eds, *Developing Basic Space Science World-Wide: A Decade of UN/ESA Workshops* (Dordrecht, 2004), notably the contributions by J. Andersen, D. McNally, and A. H. Batten; Rhys Jones and Richard Phillips, “Unsettling Geographical Horizons: Exploring Premodern and Non-European Imperialism,” *Annals of the Association of American Geographers, 95* (2005), 141-61.

98. Hardt and Negri, *Empire*, p. 156.

99. Noam Chomsky, “Rationality/Science,” *Z Papers*, special issue, 1995, available at: http://www.chomsky,info/articles/1995.

100. William A. Cochrane, Killam Lecturer in 2004, has emphasized: “Prior to the early 1980s there was suspicion and discomfort on the part of academic scientists to associate with industry; however, this has now changed to where many academic scientists have seen the benefits, both personally and for the institution, and indeed for the country, of more fully cooperating in commercializing their discoveries.” Cochrane, *2004 Killam Annual Lecture. Commercializing University Scientific Discoveries: Issues and Challenges* (Halifax, Nova Scotia, [2005]), p. 12.

101. Lanto Synge, *Art of Embroidery: History of Style and Technique* (Woodbridge, England, 2001), p. 333. Synge is with the antiques firm of Mallett in New Bond Street, London; he has a professional interest in sensing changes of taste and fashion.

102. George Steiner, *Bluebeard’s Castle*, pp. 138-9, 133, 130, in sequence.