Introduction: The History of Science in Medieval Jewish Cultures

Toward a Definition of the Agenda

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Is there an object out there answering to the name, "the history of science in medieval Jewish cultures"? Or is the history of the scientific activity of medieval Jewish scholars part and parcel of the contemporary activity in the various majority cultures in which they lived, which therefore provide the appropriate contexts for examining the history of science practiced by Jewish individuals? Inasmuch as science is the universal intellectual activity par excellence, is the history of its practice by a minority culture separable from its practice by the majority culture? Isn't the very notion of a "history of science in medieval Jewish cultures" an artificial construct informed by ethnic, nationalistic, or apologetic concerns? These are some of the questions that may cross readers' minds when they encounter the title of this book.

It is certainly not the intention to produce here a twenty-first-century remake of the "famous Jews in science" genre. Rather, the title signals the belief that the history of the absorption and practice of science within various medieval Jewish cultures constitutes a clearly identifiable object of fruitful historical investigation. Differences in local conditions notwithstanding, there is a certain inner connectedness in the story of the fortunes of science in medieval Jewish cultures. This is what makes it an intellectually legitimate and potentially fertile object of research – on the condition, to be sure, that the accounts of the practice of science by Jews are not oblivious to the respective larger, non-Jewish contexts.

One important point should be emphasized from the outset: There was not one society or one culture of medieval Jews but many. At any point in time, a multitude of very different Jewish outlooks coexisted. By "outlook" I loosely refer to the sum total of beliefs and views held to be true and norms taken as binding: It includes the set of books regarded as authoritative, the views of God and His relation to the world (theology), the interpretations of Jewish Law, and the like. Clearly, the overlap between the beliefs, say, of Maimonides and a contemporary tosafist in northern France is almost nil: They belonged to altogether different cultural systems, albeit ones that were both Jewish. Often different Jewish cultures coexisted even within a single community.

The polyphonic character of Jewish cultures was clearly perceived by a contemporary observer – the noted translator, mathematician, and poet Qalonymos ben Qalonymos (1286–after 1328), who lived in southern France and in Italy. In his poetic work *Even boḥan*

(Touchstone), which offers an amused, sarcastic-ironic view of the state of society in his day, he wrote,[1]

> Each and every district clings to its own beliefs.
> One follows its God in naive faith, devoid of rigor and profundity.
> Another innocently upholds God's corporeality;
> Yet others treat God kabbalistically or philosophically.
> And each man defames his neighbor, saying, "I fear he may have sinned,
> He may be tainted with heresy."
> His God is not like mine, and my portion is not his.

Qalonymos insightfully concludes, "Our Gods are as numerous as our towns" (cf. Jer. 2:28 and 11:13). This felicitous phrase underlines that any generalizations about *the* medieval Jewish attitude to science (or whatever) are misguided; the intellectual activity of medieval Jewish individuals has to be situated in the respective immediate (i.e., *local*) cultural contexts.

Medieval (and later) Jewish cultures were multiple, then, and each needs to be treated separately. It is erroneous, misleading, and unfruitful to refer to "Jewish culture" in the singular. (It is another question how, despite the centrifugal tendencies at work, the self-perception of all these cultures as belonging to one overarching entity called "Judaism" has been maintained, but that is not our concern here.) This idea is a cornerstone of this volume, and it is reflected in its title. The contributors to this volume, too, have sought to keep different cultures apart and to situate developments in their respective local contexts.[2]

Let us now turn to the historiographic perspective underlying this volume. It is the result of the interaction or hybridization (a concept originated by the sociologist Joseph Ben-David) of two disciplines: the history of science, on the one hand, and Jewish studies or, more precisely, Jewish cultural history, on the other. In the second half of the twentieth century, the agendas of both disciplines underwent profound conceptual and methodological changes, which have allowed them to interact in new ways and opened the route for novel perspectives on medieval Jewish scholars' engagement with science. Specifically, both disciplines moved away from apologetic or congratulatory postures toward the direction of attitudes close to those adopted by cultural studies. Their parallel evolutions have made it possible to redefine anew the objectives of studying the history of the scientific activity by medieval Jews. Let me explain briefly.

"TURNS" IN THE HISTORY OF SCIENCE

The history of science is almost as old as science itself and is in a way the natural outgrowth of the practice of science. Scientists, especially great scientists, often view themselves as standing on the shoulders of giants, whom they wish to identify. The mathematician who builds on a theorem often associates it with the individual who was the first to prove it. The physicist who draws on a law of nature to build an instrument or set up an experiment may similarly wish to know who established the fact he or she takes for granted. Note the use of the words "fact" and "established": The intuitive philosophy of science of most practicing scientists is a positivism that views science as an ever-growing collection of timeless and context-independent truths.

[1] *Even boḥan*, ed. A. M. Habermann (Tel Aviv: Maḥbarot le-sifrut, 1956), p. 44; translation by Susan Einbinder (HUC, Cincinnati), to whom I express my sincere thanks.

[2] While this volume was in gestation, David Biale edited and published *Cultures of the Jews: A New History* (New York: Schocken, 2002). The plurality of cultures in his title is of a very different kind from that to which I refer here. For him, "cultures" in the plural seems to allude to the different *kinds* of culture – material, artistic, intellectual, etc. – of which each individual partakes (see p. xvii). As far as I can see, the idea that at any point in time "Judaism" consists of a network of different cultures has not been touched upon in his useful volume.

These truths can be facts, generalizations from facts, or theories. From the viewpoint of this positivist philosophy of science, it obviously makes much sense to ask who first established a given item of knowledge.[3]

Relevant here is that positivism, as the philosophy of science embraced by both scientists and philosophers of science, shaped the traditional historiography of science. Historians of science viewed science as a set of established facts and theories. Concomitantly, they viewed science as a closed system in which progress depended only on research problems generated by science itself. Put differently, positivists perceived science as a self-contained, autonomous system. Until a few decades ago, most histories of science were indeed written without much attention to extrascientific developments, whether intellectual, social, or economic. This tendency was reinforced by the circumstance that historians of science were usually trained in the sciences, and only in the sciences, and subsequently worked in relative isolation from other disciplines. Sociologically, this meant that, as an academic field, the history of science developed a strong professional identity of its own, with historians of science talking primarily to one another. Specifically, scholars studying the history of science within a given culture communicated mainly with other historians of the same scientific discipline, and not with scholars studying other facets of the same culture.

This insular tendency of the discipline was congruent with another feature of positivism: namely, the belief in rationality as a driving force in history, especially in the history of science. The narrative of the history of science usually proceeded on the implicit assumption that humankind is rational and that science, the rational activity par excellence, would progressively push back ignorance and superstition. What is important in the present context is that positivism, like most optimistic, future-oriented rationalist philosophies of history, had little interest in or even patience for setbacks, errors, or failures. What counted were the real, positive *contributions* to science – that is, new discoveries. Scientists who spent their lives in research but who never achieved a tangible, established outcome that expanded the frontiers of knowledge and contracted those of ignorance had no place in this narrative. Nay, in positivist historiography of science, even a person who made a discovery but, as it turned out, was not the first to have made it did not "contribute" to science and thus was at best allowed an appreciative nod in a footnote to the account devoted to *the* (i.e., the first) discoverer. From a positivist point of view, it is not an individual's effort or ingenuity that matters, but only the bottom line – the net contribution to scientific progress.

Were we to look at science as practiced by medieval Jews from a positivist vantage point, the title of this book would have been "The Contributions by Jews to Science in the Middle Ages," and the contributors would have been asked to list discoveries made by individual medieval Jews that increased the previously existing body of knowledge. Then, however, there would have been no need for this book, and for two reasons. The first is that the task of tracking down and listing the contributions to science made by Jews (medieval or others) has already been accomplished to a great extent by our forerunners, the founders of the *Wissenschaft des Judentums* and their successors. Indeed, in its beginnings, many of the practitioners and supporters of the *Wissenschaft des Judentums* adopted a stance that was deliberately apologetic, seeking to demonstrate that Jews, too, like the followers of other faiths, contributed to science.[4] The main target they set themselves was to refute a prevailing

[3] So natural and intuitive is this view of science to scientists that it has become socially integrated into scientific practice itself, as reflected in the tradition of naming particularly important pieces of new knowledge after their discoverers. Robert K. Merton has shown that this practice – he called it "eponymy" – is a part of the social reward system of science.

[4] A characteristic example of a work in this spirit is Solomon Gandz, *Studies in Hebrew Astronomy and Mathematics* (New York: Ktav, 1970). Kindred in spirit are George Sarton, *Introduction to the History of Science* (Washington, D.C., 1927–48), and Edwyn Bevan and Charles Singer, eds., *The Legacy of Israel* (Oxford: Clarendon Press

image of the Jewish scholar as engaged in sterile talmudic hairsplitting, a stereotype shared by antisemites and Jewish *maskilim* alike. Felicitously, this aim was in keeping with the outlook of their contemporary positivist historians of science. The research initiated by the *Wissenschaft des Judentums* and subsequently carried further by later scholars produced highly important results on which present-day research constantly draws, but it seems fair to summarize its outcome by saying that medieval Jews played a fairly limited role in advancing science. They were important as cultural intermediaries, in the transfer of scientific knowledge from East to West, from Arabic into Hebrew and Latin; they also were creators of some new scientific knowledge, mainly in astronomy, in whose cultivation they often participated on equal footing with their Muslim and Christian counterparts. Overall, however, the positive contributions by Jews to medieval science were relatively meager and cannot be compared to those of medieval Muslim or Christian scientific cultures. From a positivist perspective, then, the intersection of the history of science and of Jewish studies is small. This is the second reason why a positivistically oriented volume on "The Contributions by Jews to Science in the Middle Ages" would have been a non-starter.

Today, however, the intellectual landscape has changed, allowing for a new approach to the historical study of the scientific activity of medieval Jews. In the 1960s and 1970s, the history of science witnessed the emergence of new perspectives that radically modified the discipline's outlook and *problématiques*. In one innovative move, scholars posited that the interest in positive scientific results should be complemented by attention to the *thought processes* that produced them: The focus on a *contribution* has been enlarged to include the *individual thinker* behind it. This broadening of the former positivist framework of analysis was accomplished by scholars who introduced approaches deriving from the history of philosophy into the history of science. Coming from the hermeneutical tradition that can be traced to Wilhelm Dilthey (1833–1911), they construed their task as understanding the historical actor who produced an intellectual construct ("discovery") in his (or, more rarely, her) own terms, expecting the interpreter to transfer him- or herself (*sich hineinversetzen*) into the mindset of the scientist studied and to try to reconstruct the creative thought processes that led to the intellectual construct under discussion. The historian who did most to introduce this tradition into the history of science was Alexandre Koyré (1892–1964). In a series of groundbreaking case studies written in the 1950s, he made the point that the history of science cannot be studied in isolation; to understand the genesis of a scientific fact or a theory, one has to attend to its author's *entire* thought, no matter if its premises are scientific or nonscientific, rational or nonrational, or even irrational. Of course, this is not to say that every scientific fact or theory is the product of dark, irrational forces, but whether or not this is the situation has to be determined by historical research in each and every case. Since Koyré, whose approach had been adumbrated or paralleled in some respects by historians of science such as Pierre Duhem (1861–1916), Gaston Bachelard (1884–1962), Anneliese Maier (1905–71), Hélène Metzger (1888–1944), Ludwik Fleck (1896–1961), and others, the thinking of many a great scientist has been shown to include various components other than strictly scientific – notably, philosophical – that in one way or another nurtured their scientific work. The new approach, which deprived science as a body of knowledge of its former epistemological insularity, was soon articulated by the anti-positivist philosophers of science of the 1960s and 1970s, above all by Thomas S. Kuhn (1922–96). It opened the way to a further, notably social contextualization of science.

1965). It is important to note that Moritz Steinschneider, a scholar in the tradition of the *Wissenschaft* who contributed more than anyone else to the study of the scientific activity of medieval Jews, was vehemently opposed to any apologetics. See Reimund Leicht and Gad Freudenthal, eds., *Studies on Moritz Steinschneider* (Leiden and Boston: Brill, forthcoming).

This redefinition of the agenda of the history of science signaled a blurring of demarcations and a lowering of barriers: Instead of juxtaposing science and nonscience, rational thought and irrational beliefs, historians now began to construe science as the outgrowth of different frames of mind, some more rational than others. The various kinds of human beliefs within the thought of a given individual may interact, making it impossible to view science as the outcome of pure human rationality alone. Consequently, although historians of science remain primarily interested in thought processes whose outcome has entered the annals of science (and not, say, the annals of magic, superstition, or religious doctrines), this new definition of the subject matter of the discipline still implies that they may have to attend to nonscientific thought and work much harder: They now have to study not only the strictly scientific ideas of a past scientist but also *all* the beliefs held by that scientist that may have nurtured his or her thought, and often also the social context in which he or she worked. To give but one example, in the case of Isaac Newton, this means that in addition to the history of astronomy, physics, and mathematics, one must also study theology, alchemy, and other nonscientific subjects. This development clearly favors the inclusion of religious aspects in the narrative of the history of science.

A second new perspective that has enriched the *problématiques* studied by historians of science is sociological. I have in mind the tradition that goes back to Max Weber (1864–1920) and that was applied to the history of science in the seminal works of Robert K. Merton (1910–2003) and Joseph Ben-David (1920–86). In a nutshell, both followed Weber's crucial insight that "the belief in the value of scientific truth is not derived from nature but is a product of definite cultures." Consequently, they assumed that the growth of science will be bolstered where there is a convergence between the general values of a given culture and those of science: Such a convergence will favor the social legitimacy and institutionalization of scientific roles and practice and will also motivate individuals to apply themselves to it, with the converse holding as well. This paradigm is particularly apt for the sociological study of the relationship of science and religion; its application to a historical case study famously led to Merton's thesis concerning the so-called Protestant spur to early modern science. In the last two or three decades, this kind of sociology of science has to some extent fallen into desuetude, but I still consider it to be critically important for a sociologically informed study of the history of science, especially of science's relationships to religious thinking and institutions. A more recent sociological tradition, the "sociology of scientific knowledge," goes further in that it tries to establish a causal link between aspects of an actor's social context and interests and his or her scientific ideas. Whatever the merits of this research program, it certainly helped end the solipsism that characterized the earlier history of science, making room for the inclusion of religious elements in the accounts given by historians of science.

These two "turns" in the study of the history of science – the hermeneutic and the sociological – are parallel in that they allow and indeed demand the introduction of extrascientific elements into the accounts of how science evolves. Foremost among these extrascientific elements are intellectual and social variables, some of which may be related to an individual's commitment to a religion or a minority culture. The inclusion of these elements clearly opens the gate for an alliance between the history of science and Jewish cultural history.

"Turns" in the field of Jewish studies

Jewish studies, too, changed in the second half of the twentieth century. The field's evolution cannot and need not be traced here.[5] I note only the following. First, the earlier apologetic

[5] For an overview, see Martin Goodman and David Sorkin, eds., *Oxford Handbook of Jewish Studies* (Oxford: Oxford University Press, 2002).

tendency has vanished almost completely; historians today are less and less preoccupied by the "image of the Jew" that their studies may imply. Instead, they treat their material as would any other student of a culture – with a distanced empathy. For example, the study of kabbalah, which nineteenth-century scholars shunned because of its perceived embarrassing irrationality, is now flourishing. A second related and more recent development is, in the words of Amos Funkenstein (1937–95), the disappearance of a comprehensive "master-narrative" in Jewish studies:

> Some recent historians seem to have lost the faith we all once shared in the existence of a single coherent and harmonious master-narrative representing reality. The place of that master-narrative . . . has been taken over by a discordant polyphony of competing and even contradictory voices, each with only relative validity, and all of them blurring and calling into question the borders between narratives and their referents, between signifier and signified.[6]

Jewish studies, then, have moved away from an explicit or implicit apologetic posture, including the need to demonstrate Jewish "contributions" to science. Its epistemological stance is more intent on satisfying scholarly norms than on responding to the concerns of a lay public.

A NEW ALLIANCE OF THE TWO DISCIPLINES

When we pull all the strands together, we find the following picture: The new construal of the scope and objectives of the history of science, on the one hand, and the developments within Jewish historiography, on the other, have set the stage for a new alliance between the two disciplines. This alliance has two aspects: (1) internal, associated with the history of ideas, and (2) external and sociological. The first considers the intellectual relations between ideas upheld within Judaism and the science elaborated by Jews; the second considers Jewish culture as a factor that socially encouraged or discouraged the practice of science by Jews. Consider them in turn.

Inasmuch as historians of science no longer limit their researches to the history of positive "contributions" to science, and inasmuch as historians of Jewish thought, too, no longer feel they must come up with Jewish "contributions" to universal culture, new legitimate and attractive topics of research emerge in both disciplines. For one thing, considering the work of a medieval Jewish scientist, one may ask (à la Koyré) whether ideas or *problématiques* deriving from his Jewish culture interfered with his scientific work in one way or another, irrespective of whether that work resulted in a positive contribution to science. (Answers in the affirmative can be offered for Maimonides, Gersonides, and Ḥasdai Crescas, among others.) For another, diverse views of nature and of natural phenomena held by medieval Jews, including some that were not scientific by any standard, have now become acceptable objects of historical research (examples are provided later). This new, broad, and nonpositivist stance creates a multileveled rapprochement between the perspectives and *problématiques* of the history of science and of Jewish studies, in which their disciplinary differences tend to blur.

This new perspective raises questions about the demarcation of the discipline. Consider just one example: If we recall that, in the medieval philosophical tradition, the material sublunar world was taken to be structured and held together by the active intellect, the last entity emanating from the First Intellect, then we quickly realize that it is not easy to separate the history of physical science from that of metaphysical thought. How, then, should we circumscribe the subject matter of the history of *science*? As far as this volume is concerned,

[6] See Amos Funkenstein, "Jewish History among the Thorns," pp. 309–27 in *Thinking Impossibilities: The Legacy of Amos Funkenstein*, ed. Robert S. Westman and David Biale (Toronto: University of Toronto Press, 2008), on p. 310; originally published (in Hebrew) in *Zion* 60 (1995): 335–47.

I deemed it best to avoid defining "science" in any formal way and instead to define the object of the history of medieval science loosely, as including all discussions bearing on conceptions of the natural world, in addition to formal thought (mainly logic and mathematics). First and foremost, this definition covers all works written by medieval Jewish authors within or with reference to the broad framework of the Greco-Arabic scientific tradition. This is a vast corpus bearing on the exact sciences, logic, natural philosophy, biology, metaphysics, and related disciplines. Most of these texts are in Arabic or in Hebrew (only a few are in various vernaculars). The proposed definition acknowledges the blurring of the borders between science and metaphysics and treats all reflections on nature as a continuum of related theories. It also allows the inclusion of thoughts about nature that fall outside this rationalist tradition, such as in *Sefer Yeṣirah* (Book of Creation). Similarly, we can include lapidaries, describing the (more or less magical) properties of gems, or mystically inclined texts like the accounts of natural phenomena written within the tradition of the German Pietists. Thus, although work by Jewish scholars in the rationalist tradition of Greco-Arabic science constitutes the hard core of the historian of science's study, texts from outside this tradition can provide an important complement to the picture. The unity and cohesion of the field have a pragmatic rather than theoretical basis.

I now come to the sociological component of the new alliance. Our point of departure is the assumption that, to understand properly what Jews did or did not do in the sciences during the Middle Ages, we have to situate the carriers and producers of knowledge in their social and cultural contexts and assess how the values of the local culture favorably or adversely influenced the practice of science. Among other things, we must be on the lookout for the roles played in society by medieval Jewish carriers and producers of knowledge.[7] A sociologically informed account of the scientific activity of individuals will have to consider their specific and local sociocultural context.

The new alliance between the disciplines of Jewish studies and the history of science is already taking shape: Scholars who study the science practiced within Jewish traditions come from different horizons and define their professional identities in a variety of ways. Those interested in Jewish thinkers' engagement with the exact sciences continue to relate to the work of their colleagues who study the history of these sciences in other cultures. These historians' professional identity is well established, and they contribute much both to the social coherence of our field of study and to maintaining its links with the academic discipline of the history of science. Other scholars, coming from Jewish studies, are interested in texts and processes that may not seem significant to "general" historians of science: In these cases, they situate the individuals and texts they study not in the context of the global history of science but also in that of the history of Jewish thought. They often relate to historians of kindred ideas in other cultures, although usually students of Jewish cultures are their main audience. Obviously these two groups of scholars share many research topics and interests, notwithstanding their partly different scholarly agendas and professional reference groups. Indeed, in the last decade or two, a small cross-disciplinary field of study has emerged, straddling the history of science and Jewish studies. This field has no intrinsic boundaries, chronological or other: Inasmuch as the intellectual activity (scientific or other) of an individual has been significantly informed by Jewish culture, he or she is a legitimate object of the kind of study here described. Clearly, because in modern times the work of scientists tends to have little to do with their possible Jewish background, the share of studies bearing on the premodern period tends to be preponderant. The scientific community now active

[7] This sentence obviously echoes the title of Joseph Ben-David's *The Scientist's Role in Society* (Englewood Cliffs: Prentice-Hall, 1971; 2nd ed., Chicago: University of Chicago Press, 1984). The influence of my late teacher's thought on the approach adopted here is unmistakable.

in this field has endeavored to institutionalize its existence through conferences and, since 2001, in a dedicated scholarly journal, *Aleph: Historical Studies in Science and Judaism*.

This brings us to a final question: If scientific ideas were not high on the agenda of most medieval Jewish scholars and if, moreover, their work was of limited consequence for the general history of science, then why should we bother studying the history of science within medieval Jewish cultures? There are, I think, at least four good justifications for this enterprise.

The first is obviously that the "Jewish component" in the history of medieval science is a significant component of the global picture. Two distinct levels must be taken into consideration here – that of scholars who creatively came to grips with science, and that of the "consumers" of scientific lore. On the first, traditional, level, we attend to Jews' positive contributions to astronomy and to their role as cultural intermediaries. This is too well known to call for elaboration. We also study intellectual gems that one finds here and there, as in the thinking of a Gersonides or a Ḥasdai Crescas in the rationalist tradition, or in the idiosyncratic thought of Judah the Pious in the more mystical tradition. Whether or not they made a difference for subsequent developments, studying them is intellectually rewarding. This is in keeping with wider tendencies in scholarship: Historiography in general, including the history of ideas, has moved away from the cult of "Great Men," and the study of how lesser luminaries apprehended the world is drawing increasing attention. This brings us to the second level of analysis, that of the place of science in Jewish intellectual life. Although only a few Jews made notable contributions to medieval science, many Jewish individuals were interested in science and studied it intensively. This unflagging interest in science is reflected in the considerable number of works offering introductions to science that were written in Hebrew (or translated into it) during the medieval period and were subsequently copied, transmitted, and studied. Also, more advanced scientific texts were studied by learned individuals who nonetheless never entered history. Although these individuals are "consumers" rather than creators of scientific knowledge, they are an integral part of the history of science: The *Annales* school of historiography has taught us that historical writing should not focus on past great events or important personages, but rather also study the lives of "ordinary people"; by the same token, studying the history of scientific thought should include within its purview how science was studied and transmitted by "ordinary" literate persons. This kind of study throws important light on the intellectual and spiritual world of Jewish medieval cultures.

A second reason for studying the Jewish medieval scientific tradition is its impact on other domains of Jewish thought. In many geographical areas and during many periods, practically all Jewish intellectuals appropriated at least some science. Consequently, scientific ideas and concepts permeate a large part of medieval writings, including in philosophy, biblical commentary, halakhah, belles lettres, and even kabbalah. Consequently, anyone who wishes to read medieval (and many post medieval) Jewish texts today must be familiar with the basics of medieval science. Studying the history of the reception, absorption, and further development of scientific ideas within medieval Jewish cultures is thus a prerequisite for the study of the history of Jewish thought, medieval and later.

The third reason is admittedly pragmatic, indeed pragmatic with a whiff of apologetics. The history of science is a well-entrenched, strongly institutionalized discipline that, owing notably to its connections with modern science and science policymaking, is increasingly visible in the public sphere. The scholarly consensus reached within this discipline ultimately shapes the general public's understanding of who contributed what to science, which is a central component of modernity. Societies, cultures, and minority groups vie for a significant place in this narrative, more openly and self-consciously today than in the past. Thus there is a certain ideological stake involved here; it is fitting and desirable that Jewish cultures not be

absent from the narratives of medieval science offered to the general public by professional historians. In the European community, for example, there is an ongoing debate about Europe's "identity": Is it essentially Greek and Christian, or have "alien" inputs become a part of the European essence? In this context, it seems important that the input of Jewish (and other non-Christian) cultures into Europe's culture be highlighted, so as to allow its impact to be clearly perceived by the general public.

Last but not least, the reception and absorption of scientific and philosophical thought in the rationalist Greco-Arabic tradition by medieval Jewish cultures are central aspects of the general theme of "Athens and Jerusalem" (i.e., of Jewish attitudes toward general, non-Jewish culture).[8] The origins of this question go far back, but it became a fundamental cultural issue of Jewish life following the encounter between Judaism and Greco-Arabic culture in early Islam and has remained so to this very day. To cite only one example, Maimonides insisted that without Aristotle's help it was impossible to understand the Scriptures correctly; hence the study of the sciences was not only legitimate but also mandatory. Other Jewish authorities steadfastly held that the slightest compromise with philosophy placed Judaism in grave jeopardy. We have here two principled views of Judaism, one advocating openness toward the outer, gentile world and its cultures – "hear the truth from whoever utters it," as Maimonides put it – and the other insisting on closure and isolation. In the persistent, occasionally violent conflict between these two principled Jewish stances, science played an essential mediating role inasmuch as even those who have been hostile to the study of "alien wisdom" have recognized the utility of disciplines such as mathematics, astronomy, and medicine. Consequently, one aspect of our theme is the history of the acceptance or rejection of rationalist thought, and of "foreign" ideas in general, by the various medieval Jewish cultures. The history of attitudes to science is a significant, perhaps even crucial, dimension of Jewish cultural history that calls for description and analysis. With an eye to the present, we note that these historical studies may afford some insight into the nature of religious fundamentalism and its attitudes toward the scientific way of thinking. In short, the history of scientific thinking within medieval Judaism may not be an essential component of the history of science, but it certainly is a significant chapter in the cultural history of Judaism itself.

It does not seem necessary to me to offer here an overview of the contents of the volume; the chapter titles clearly enough indicate what they are about. Yet a short observation on how the completed volume relates to the programmatic ideas exposed earlier is in order.

Some ideas have been successfully implemented. Thus the volume includes chapters on subjects that often find no place in works on the history of science – for instance, astrology, astral magic, psychological theories, and theories of language. Similarly, the contributors endeavored to consider developments within different Jewish cultures separately, rather than to refer to an undifferentiated entity called "Judaism." By contrast, the goal of providing a culturally contextualized history of Jewish engagement with the different scientific disciplines was attained only partially: Whereas some contributions made important steps in this direction, other chapters provide more traditional accounts of textual history. They grapple with such Steinschneiderian questions as: Which texts were translated, when, where, and by whom; who studied these texts; and in what ways. This is inevitable inasmuch as at the present stage of scholarship, much spadework of this kind is still necessary before more contextual issues relating to cultural history can be broached.

[8] For an overview and bibliography, see Jacob J. Schacter, ed., *Judaism's Encounter with Other Cultures: Rejection or Integration?* (Northvale, N.J., and Jerusalem: Jason Aronson, 1997).

Contingent circumstances also played a role in shaping the volume. To my regret, a number of important topics have remained untreated – for example, science in the Talmud and its perception in the medieval period, the interaction between science and halakhah, the interaction between science and medicine, the impact of Hermetic writings on science, the reverberations of scientific lore in belles lettres, and the science of music. More felicitously, owing to other contingent circumstances, the volume includes not one but two (complementary) chapters on Jewish astrology (in addition to one on astral magic). It also is obviously the case that, owing to disparities in the progress of research in different areas (not to mention individual differences), the treatments of the various subjects are not equally exhaustive. This volume, then, represents a snapshot of the "state of the art" at a particular moment. It is hoped that it will contribute to the further development of our subdiscipline and that it will soon be outdated.

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