

# THE CONFLICT BETWEEN RELIGION AND SCIENCE IN LIGHT OF THE PATTERNS OF RELIGIOUS BELIEF AMONG SCIENTISTS

by C. Mackenzie Brown

*Abstract.* Recent summaries of psychologist James H. Leuba's pioneering studies on the religious beliefs of American scientists have misrepresented his findings and ignored important aspects of his analyses, including predictions regarding the future of religion. Much of the recent interest in Leuba was sparked by Edward J. Larson and Larry Witham's commentary in *Nature* (3 April 1997), "Scientists Are Still Keeping the Faith." Larson and Witham compared the results of their 1996 survey of one thousand randomly selected American scientists regarding their religious beliefs with a similar survey published eighty years earlier by Leuba. Leuba's original studies are themselves problematical. Nonetheless, his notion that different fields of science have different impacts on the religion-science relationship remains valid. Especially significant is his appreciation of religion as a dynamic, compelling force in human life: any waning of traditional beliefs does not mean a decrease in religious commitment but calls for a new spirituality in harmony with modern scientific teachings. Leuba's studies, placed in proper context, offer a broad historical perspective from which to interpret data about religious beliefs of scientists and the impact of science and scientists on public beliefs, and opportunity to develop new insight into the religion-science relationship.

*Keywords:* belief in God; deterministic law; disbelief; future of religion; James H. Leuba; reformation of religion; religion in America; religious beliefs of scientists; supernaturalism.

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SOME PUZZLING STATISTICS ON THE RELIGIOUS BELIEFS  
OF SCIENTISTS

My inquiry into the religious beliefs of scientists was prompted five years ago when I started teaching courses in religion and science. Knowing of my interests, a Christian colleague in chemistry sent me Edward J. Larson and Larry Witham's commentary in *Nature* titled "Scientists Are Still Keeping the Faith" (1997, 435–36). Larson and Witham compared the results of their 1996 survey of one thousand randomly selected American scientists regarding their religious beliefs with a similar survey published eighty years earlier by psychologist James H. Leuba. Using Leuba's questions, they focused on beliefs concerning two cardinal doctrines of Christianity: a personal God who answers prayer and personal immortality. Their aim was to test a prediction of Leuba's that disbelief in God among scientists "would increase as education spread."

Larson and Witham reported that in both Leuba's and their own surveys roughly 40 percent of scientists believed in a personal God and an afterlife, 45 percent were disbelievers, and 15 percent were doubters. The title of their commentary summarized their main conclusion, which they expanded in the text: "to the extent that both surveys are accurate readings, traditional Western theism has not lost its place among U.S. scientists, despite their intellectual preoccupation with material reality" (1997, 435). Leuba's prediction had proven incorrect. At the same time, the authors noted: "today, *even more than in 1916*, most scientists have no use for God or an afterlife" (p. 435; emphasis added).

Although during the eight decades there was only a slight, perhaps insignificant, drop regarding belief in God (41.8 percent to 39.3 percent), Larson and Witham called attention to a large downward shift in the belief in immortality (from 50.6 to 38 percent).<sup>1</sup> Moreover, as is clear from the table of survey results accompanying their commentary, outright disbelief in immortality—as opposed to doubt or agnosticism—dramatically increased over the same period, from about 20 to 46.9 percent. Outright disbelief in God increased more modestly, from 41.5 to 45.3 percent.

One of the more intriguing conclusions reached by Larson and Witham was that, despite little change in the overall proportion of believers to non-believers (disbelievers and doubters or agnostics<sup>2</sup>) between 1916 and 1996, there was considerable change in the three professions surveyed. The three fields were reported to be "mathematics, biology and physics/astronomy," and in the same proportion as in Leuba's study: "half biologists and a quarter each in maths and physics/astronomy." The authors discovered that in 1996 "mathematicians are most inclined to believe in God (44.6%)," with physicists and astronomers least inclined (22.1 percent),<sup>3</sup> whereas in 1916 biologists were least inclined (30.5 percent).<sup>4</sup>

In a second brief article—a letter to *Nature* appearing more than a year later—Larson and Witham reported on "a second phase" of Leuba's earlier

study, a comparison of belief rates between scientists overall and “greater” scientists (1998, 313). Leuba had found, according to Larson and Witham, that while 58 percent of scientists overall expressed disbelief or doubt in God’s existence, nearly 70 percent of the more eminent scientists (constituting four hundred out of the one thousand polled) were nonbelievers.<sup>5</sup> Leuba conducted a follow-up survey in 1933<sup>6</sup> and found that 67 percent of scientists overall and 85 percent of “greater” scientists had become nonbelievers.<sup>7</sup> Larson and Witham in 1998 conducted their own follow-up survey of top scientists, using of necessity a more elite sample than Leuba’s.<sup>8</sup> They discovered that, in their group of top scientists, belief in God and in immortality was 14.3 percent and 15 percent, respectively, for mathematicians; 5.5 percent and 7.1 percent for biological scientists; and 7.5 percent and 7.5 percent for physicists and astronomers. In their summary chart comparing their findings with Leuba’s two surveys, we find the figures for belief in God for all “greater” scientists for 1914, 1933, and 1998 to be 27.7 percent,<sup>9</sup> 15 percent,<sup>10</sup> and 7.0 percent, respectively.

I thought that the topic of scientists’ religious beliefs would be of interest to my students, so I began collecting responses to the Larson and Witham articles. One of the first I came across was an 11 April 1997 article in *The Chronicle of Higher Education*, by David L. Wheeler. Regarding the shifting pattern of belief in the three professions, Wheeler summarized Larson and Witham’s findings as follows: “Mathematicians are the most likely to believe in God now, but in 1916 scientists in a combined category of physicists and mathematicians were the most likely believers. Today, physicists and astronomers are the most apt to doubt the existence of God, while biologists are the least likely to be skeptics” (Wheeler 1997, A16). Clearly Wheeler had misread the conclusions of Larson and Witham, combining the different groups of scientists haphazardly and contradicting himself with regard to the lack of skepticism among contemporary biologists.<sup>11</sup>

By now I was beginning to wonder exactly what Leuba had discovered about the three, or four, professions of astronomers, physicists, mathematicians, and biologists. So I decided to follow what Stephen Jay Gould has called “the primary rule of intellectual life”—namely, “when puzzled, it never hurts to read the primary documents—a rather simple and self-evident principle that has, nonetheless, completely disappeared from large sectors of the American experience” (Gould 1997, 18).<sup>12</sup>

#### LEUBA’S INVESTIGATIONS AND CONCLUSIONS

For his book *The Belief in God and Immortality* (1916) Leuba surveyed the religious beliefs both of American college students and of various groups of scientists and other intellectuals. The American public was generally shocked by his findings once they were publicized by William Jennings Bryan, who referred to the “evil influence of . . . Materialistic, Atheistic or Agnostic professors” in fostering disbelief among college students as revealed

by Leuba's investigations (Bryan 1922, 118).<sup>13</sup> Regarding the scientists and intellectuals, Leuba focused on the two intriguing issues noted by Larson and Witham: the patterns of belief among the several groups according to their eminence, on one hand, and their field of expertise, on the other. In addition to providing the basic statistics disclosing these patterns, Leuba offered various interpretations of his findings along with predictions regarding future trends.

*Leuba's Procedures and Methods.* Leuba's study of scientists and other intellectuals was based on a 1914 mail survey of the following groups: 1,000 scientists, 202 historians, 197 sociologists, and 107 psychologists.<sup>14</sup> Slightly more than 75 percent of the scientists returned completed questionnaires.<sup>15</sup> The response rate from the other groups, with the exception of the historians, was less (Leuba 1916, 227–28, 246–47). The survey dealt with the two basic questions mentioned earlier that Leuba saw as central to traditional Christian faith and practice: belief in a personal God who responds to prayer and belief in some sort of personal immortality.

In reviewing Leuba's procedures, I have restricted myself mainly to discussion of his scientists, because this group constituted the largest segment of intellectuals by far and clearly reveals the problems of interpretation regarding the beliefs of different subgroups of scientists. It is also the group focused on by recent studies. Leuba obtained the names of the 1,000 scientists from J. McKean Cattell's *American Men of Science: A Biographical Directory* (1910).<sup>16</sup> Leuba tells us that he separated the 1,000 scientists from the *Directory* into two "divisions" of 500 each, as a means of ensuring that both samples would be random and representative of all 5,500 entries.<sup>17</sup> The form of the questionnaire mailed to the second division was somewhat different, in order to clarify the meaning of the questions on the first form. After providing the exact text of each form, Leuba discussed his reasons for the changes as well as the possible effect on the results (1916, 226).<sup>18</sup>

Each division included 200 eminent scientists and 300 less eminent ones. To distinguish "greater" from "lesser" scientists, Leuba was fortunate that Cattell's *Directory* placed an asterisk beside the field of expertise of the more eminent, totaling somewhat over 1,000 of the approximately 5,500 entries. These thousand-plus names were chosen by ten leading scientists in each of twelve "fundamental sciences" (considered below).<sup>19</sup>

In addition, Leuba divided the 500 scientists of his Division II into "physicists" and "biologists" (Leuba 1916, 249, 254).<sup>20</sup> Apparently the idea for keeping the answers separate for the two fields occurred to Leuba only after the first set of mailings. Leuba provides a general definition of these two fields in a 1934 article in *Harper's Magazine*: "In the first [field of physicists] I included all the scientists concerned with inanimate matter—physicists proper, chemists, geologists, astronomers, engineers, etc.; in the

second [field of biologists], all those concerned with living matter—biologists proper, physiologists, bacteriologists, botanists, horticulturalists, etc.” (1934, 293). Leuba provided no breakdown of the number of scientists in each discipline included in his survey.

The individuals selected for the survey, Leuba affirmed, were chosen “by a rule of chance” (1916, 248), with such procedures, for the lesser scientists, as selecting the first and second names on alternate pages of the *Directory*, with various adjustments.<sup>21</sup> For the greater scientists, Leuba chose every fifth starred name, starting at the front or the back for the two divisions, respectively.

Several shortcomings in Leuba’s study are obvious today, such as the questionable randomness of his polling methods and his use of different wording in his questionnaires for the two divisions.<sup>22</sup> He also did not provide any analysis of the statistical significance of his data. To be fair, we must recognize that Leuba not only was a pioneer in the effort to conduct such surveys, he was also at least aware of many of the problems, frequently discussing them at length.

Here I wish to focus on one limitation of his study that could have a significant impact on his (as well as current) interpretations of his data. From the beginning of my investigations, I wondered whether there might not be significant differences in patterns of belief if specific disciplines, as well as the general fields of “biologists” and “physicists,” were considered—information that Leuba chose not to collect. It is not possible today to recover Leuba’s exact lists from the *Directory*, because his account of the procedures used is at times vague,<sup>23</sup> but a fair approximation can be made by following his directions as far as possible and using discretionary judgments when necessary.

In reconstructing Leuba’s lists, I noted the specific discipline (geology, pathology) for each of the selected scientists as they were entered in the 1910 *Directory*.<sup>24</sup> To avoid a proliferation of subdisciplines, I grouped various specialties into a single category—for example, sanitary engineers, mechanical engineers, electrical engineers, and civil engineers into “engineering.”<sup>25</sup> I was guided in my choice of basic categories for the disciplines by Cattell himself. In various editions of the *Directory*, he referred to the following twelve “fundamental sciences,” alluded to above: mathematics, physics, chemistry, astronomy, geology, botany, zoology, physiology, anatomy, pathology, anthropology, and psychology. The fifth edition provides an expanded list of sciences, noting various additional “applied” fields such as engineering, medical sciences, and agriculture (Cattell and Cattell 1933, 1264). “Medical sciences” is actually a mixed category, including both physicians/surgeons (“applied”) and anatomists, pathologists, and physiologists (“fundamental”).<sup>26</sup> Leuba himself apparently took the physical sciences to include Cattell’s first five fundamental sciences (mathematics, physics, chemistry, astronomy, and geology) plus engineering and the

biological sciences to include the next five fundamental sciences (botany, zoology, physiology, anatomy, and pathology) plus agriculture and the applied medical sciences.<sup>27</sup>

My reconstructed lists of lesser and greater scientists, with the numbers of scientists in specific disciplines, appear in Tables A-1 and A-2 in the Appendix. Table 1 below presents the proportion of scientists in each discipline relative to the total number of scientists in various subgroups (a–d), according to the data collected for Tables A-1 and A-2. Columns a and b represent the Division I lesser scientists selected by using odd-numbered and even-numbered pages, respectively. Columns c and d represent greater scientists selected by choosing every fifth starred name beginning at the front of the *Directory* (for Division I), and starting at the end (for Division II), respectively. Total percentage figures for the physical and biological sciences in any given column should add up to 100 percent (except for rounding).<sup>28</sup>

Immediately striking in these data is the marked decrease in the applied sciences among the greater scientists, for both the physical sciences (the engineers almost disappear) and the biological (the agricultural scientists decrease greatly, while those in medicine suffer a somewhat smaller reduction). The actual decrease is probably even greater than the figures in Table 1 indicate. For instance, the 1910 edition of Cattell's *Directory* (p. 538) specifically mentions chemistry as representing "in part professional work in applied science," confirming my impression that a large number of chemical engineers are among the chemists. The decrease in chemistry, along with increases in the disciplines of astronomy, mathematics, and physics—disciplines generally considered to be nonapplied—suggests that the greater scientists are significantly more preoccupied with "basic" research than are the lesser scientists.<sup>29</sup> The relative paucity of applied scientists among the more eminent may well be relevant to any interpretation of the underlying reasons for the disparity in belief levels.

My reconstruction of the relative proportion of scientists in different disciplines in Leuba's survey, incidentally, raises serious questions about the reliability of Larson and Witham's recent reports. They insist, we may recall, that they followed Leuba's apportionment of "half biologists and a quarter each in maths and physics/astronomy" (1997, 435). Even Leuba, generally vague about proportions, provides one chart that makes it reasonably clear that biological scientists constituted only about 35 percent, rather than 50 percent, of the total sample (1916, 251).<sup>30</sup> The figures in Table 1 suggest problems in Larson and Witham's reference to astronomy (less than 5 percent) while neglecting any mention of chemistry, engineering, and geology—all with larger, sometimes much larger, overall representation than astronomy. Chemistry is the largest single group, with engineering, at least for lesser scientists, well ahead of both physics (as a specific discipline) and mathematics. The source for Larson and Witham's

categories, as far as I can guess, may be found in an apparent attempt to reconcile Leuba's two general fields with the specific disciplines named in the 1995–96 edition of *American Men and Women of Science*. These specific disciplines include “biological sciences,” “mathematics,” and “physics & astronomy.” As we have seen, these do not correspond to Leuba's “biological scientists” and “physical scientists.” The source for Larson and Witham's proportions remains to me a mystery.

**TABLE 1**  
**Disciplines as Percentage of Total**  
**for the Lesser and the Greater Scientists**  
**(for Lesser Scientists, Division I only, using odd and even methods,**  
**and for Greater Scientists Divisions I and II)**

	(a) Div I Lesser Scientists (odd pages) % of field (n=281)	(b) Div I Lesser Scientists (even pages) % of field (n=281)	(c) Div I Greater Scientists % of field (n=186)	(d) Div II Greater Scientists % of field (n=184)
<b>Physical Sciences</b>				
Astronomy	2.5	2.8	3.8	4.9
Chemistry	18.5	22.1	16.1	15.8
Engineering	13.5	10.7	1.6	1.6
Geology	6.8	12.5	9.7	10.3
Mathematics	6.8	8.2	12.4	10.3
Physics	7.8	8.5	12.9	13.6
<b>Total</b>	<b>55.9</b>	<b>64.8</b>	<b>56.5</b>	<b>56.5</b>
<b>Biological Sciences</b>				
Agriculture	6.8	3.6	0.0	2.2
Anatomy	1.4	1.1	3.2	4.3
Botany	8.5	6.4	13.4	9.8
Medicine	8.5	7.1	4.8	3.8
Pathology	2.1	1.4	2.7	3.8
Physiology	1.4	2.1	5.4	4.9
Zoology	15.3	13.5	14.0	14.7
<b>Total</b>	<b>44.0</b>	<b>35.2</b>	<b>43.5</b>	<b>43.5</b>

*Leuba's Findings: Patterns of Belief among Scientists and Intellectuals.* In Tables 2 and 3 I summarize Leuba's findings regarding the two fundamental beliefs of traditional Christian faith for his five groups (including the physical and biological scientists of Division II). Recent reviews of Leuba's studies, incidentally, usually neglect his findings regarding historians and behavioral scientists, focusing only on the physical and biological sciences.<sup>31</sup> Table 2 contains the data for all of Leuba's intellectuals, lesser and greater, combined; Table 3 for greater intellectuals only. The figures represent the percentage of believers in each group, as compared to outright disbelievers, mere doubters, agnostics, and those with no definite beliefs.<sup>32</sup> (The figures for sociologists are for professors only.<sup>33</sup>)

These data indicate that the greater intellectuals in every field show lower levels of belief than their lesser counterparts. Further, physical scientists and historians share somewhat similar levels of belief in God and immortality, whereas biological scientists, sociologists (who are professors), and psychologists show significantly lower levels of belief. And finally, belief in God is less than belief in immortality for all groups except psychologists. For ease of comparing the physical and biological scientists according to eminence, Table 4 provides the relevant data, clearly indicating the higher levels of disbelief in God among biological scientists. Table 5 provides the

TABLE 2  
Beliefs of All Intellectuals

Lesser and Greater Together	Believers in God	Believers in Immortality
Historians	48.3	51.5
Physical Scientists	43.9	50.7
Biological Scientists	30.5	37
Sociologists	24.4	40
Psychologists	24.2	19.8

TABLE 3  
Beliefs of Greater Intellectuals

Greater Only	Believers in God	Believers in Immortality
Historians	32.9	35.3
Physical Scientists	34.8	40
Biological Scientists	16.9	25.4
Sociologists	19.4	27.1
Psychologists	13.2	8.8



data pertaining to the scientists of Divisions I and II together, subdivided by eminence, for belief in a personal God.<sup>34</sup> It is Leuba's last figure in Table 5, the 41.8 percent combining both divisions as well as lesser and greater scientists, that is often cited today (and commonly rounded to 40 percent) as the reference point for measuring increases or decreases in religious belief among scientists over the last eighty-plus years.

*Leuba's Interpretations of the Causes of Greater Disbelief among the More Eminent.* Leuba offered two distinct, complementary interpretations of his findings, the first regarding the different belief levels between the lesser and greater scientists and the second regarding the differences between various intellectual fields. As for the first, one might suppose it is due to the more extensive knowledge, experience, and competence of the more eminent intellectuals. Leuba argued, however, that it is not so much the greater knowledge or intellectual abilities of the more eminent that lead to their higher levels of disbelief as it is their greater intellectual and moral independence. Such qualities, he continued, are reflective of initiative and self-reliance, factors that "tend to resist the forces of tradition, of authority, and of prestige" (1916, 286). Leuba insisted, "I conclude, therefore, that the greater loss of belief suffered by the greater men is probably not to be ascribed chiefly to their greater knowledge, but rather to certain

TABLE 4

**Leuba's Statistics on Belief in God for Lesser and Greater Scientists according to Field (for Division II Only)**

	Lesser Scientists	Greater Scientists	Lesser and Greater
Physical Scientists	49.7	34.8	43.9
Biological Scientists	39.1	16.9	30.5
Combined	45.5	27.7	38.4

TABLE 5

**Leuba's Statistics on Belief in God for Lesser and Greater Scientists according to Division**

	Lesser Scientists	Greater Scientists	Lesser and Greater
Division I	51	35.7	45.2
Division II	45.5	27.7	38.4
Combined Divisions	48.2	31.6	41.8

temperamental qualities or energies which make it relatively easy for them to rid themselves of much of the social pressure to which others yield" (1916, 287).<sup>35</sup>

This "independence and self-reliance" theory has a certain intuitive appeal, but it underplays the complexity of interaction between science and religion and overlooks the many instances in which traditional theological convictions have inspired some of the greatest scientific breakthroughs, as happened with Nicolaus Copernicus in astronomy and James Hutton in geology. In any case, Leuba idealized the independent mind and its role in scientific discovery, in part because of his reading of the history of traditional religion's impact on science as thoroughly negative.<sup>36</sup>

At the same time, it would be hard to insist that intellectual independence has no bearing on scientific discovery and equally difficult to deny that such independence has no effect on religious beliefs. For Leuba the connection between independence and disbelief was amply demonstrated by his survey of college students. Commenting on the increase in disbelief among the students during the course of their college careers revealed by his data, he concluded, "The chief influence on the decrease of belief among older students should be ascribed, in my opinion, to the gain in independence which is a normal result of growth and education" (1916, 283).

Other interpretations of his data were immediately forthcoming. In one of the early reviews of Leuba's study, the Harvard theologian W. W. Fenn noted that while "growing intelligence and independence" on the part of older students and the more eminent intellectuals may account for their increased disbelief, it is also possible to see their skepticism as due to "absorbing devotion to a particular field of study [that] inhibits interest and thought in other directions." He thus argued that the observed increase in skepticism may well be due to a narrow intellectualism that "may be less truly appreciative of reality than one influenced also by other and more broadly human considerations" (Fenn 1917, 396; cf. Lane 1917, 624).

If one could present a persuasive case that a Ph.D. degree represents a narrowing of intellectual interest, then with regard to the most eminent intellectuals, Fenn's alternative theory might have some plausibility. Fenn's notion of narrow intellectualism to account for the increase of skepticism among college students is unconvincing, however, because the college experience, even in Fenn's day, was surely one that tended to broaden a student's horizons in various areas of arts, humanities, and sciences.

"Narrow intellectualism" seems equally unable to explain the lesser levels of belief in a personal God that Leuba discovered among college men (56 percent) than among women (82 percent).<sup>37</sup> Leuba saw the women's greater belief as due to their greater aversion to risking isolation from their social groups and, thus, their being less free from the influence of social pressures (Leuba 1916, 202–3, 211, 284–85). The greater dependence of

women on tradition was clearly revealed, Leuba maintained, in the fact that 32 percent of the men but only 17 percent of the women felt that the nonexistence of God would make no difference in their lives (Leuba 1916, 211). While regarding women's greater dependence and conservatism as "not seriously contested," Leuba left open the question of cause—whether it could be attributed to "a secondary sexual difference or merely the product of [their] education and social position" (Leuba 1916, 284).<sup>38</sup> It would be interesting to know what differences between the sexes Leuba might have discovered among the scientists, but as he commented years later, "Among the scientists there were too few women to permit comparison with the men" (Leuba 1950, 198).

Inclusion of the applied-science factor noted above might bolster Leuba's emphasis on intellectual independence. A course of studies in an applied science such as engineering may not involve much critical thinking about one's worldview—or at least may not appear to do so to those entering such a program. Focus on technological training may not encourage the development of independence and self-reliance, especially with regard to the traditional or orthodox beliefs of one's family and social group. Michael Cavanaugh notes, for instance, that contemporary fundamentalists often hope for their children to study engineering because, in their minds, "unlike law (not to mention literature, or philosophy), engineering devises simple solutions to practical problems, without seriously challenging the intellectual traditions of any subculture" (1985, 185). To the extent that such perceptions reflect the actual training experience of students in the applied sciences, the greater proportion of applied scientists in the lesser group of scientists may, on Leuba's theory, account for their greater level of belief.<sup>39</sup>

Such a conclusion is supported by an insightful model of American scientists' religious belief proposed by Larson and Witham. This model presents a "three-tiered ziggurat" of belief, with elite scientists of "acute disbelief" at the top and non-elite scientists in nonapplied fields in the middle, with a belief rate less than half of the general public. Forming the broad base are the applied scientists ("physicians, engineers and members of other technological occupations"), similar in their belief to the American public at large (Larson and Witham 1999, 90).

Regarding other possible causes of greater disbelief among Leuba's elite, the higher level of skepticism may be due in part to a likely higher proportion of "biologists" among the more eminent.<sup>40</sup> For, as Leuba's statistics clearly indicate (see Table 4), "biologists" on the whole, in his study, are more skeptical than "physicists."

*Leuba's Interpretations of the Causes of Different Belief Levels between Historians, Physicists, Biologists, Sociologists, and Psychologists.* Although Leuba did not emphasize the role of greater knowledge in promoting disbelief, one particular aspect of "superior knowledge," as he called it, played

a key role in his interpretation of the data: the recognition of deterministic law throughout the universe. To explain the different levels of belief between historians and physical scientists on one hand (approximately 44–48 percent overall and about 33–35 percent for the more eminent) and biological scientists, sociologists, and psychologists on the other (about 24–31% overall, 13–19% for the more eminent), Leuba reasoned that the latter “have come to recognize fixed orderliness in organic and psychic life, and not merely in inorganic existence; while frequently physical scientists have recognized the presence of invariable law in the inorganic world only” (1916, 279).

For Leuba, recognition of the “reign of law” is destructive of traditional religious beliefs, as it undermines the plausibility of the notion of God’s intervening hand. The more universal one perceives the application of the reign of law to be, the more fully one realizes the deterministic nature of the world. When one accepts determinism in the biological, sociological, and psychological domains as well as in the physical, according to Leuba, belief in any sort of divine providence becomes practically impossible.<sup>41</sup>

This is seen most clearly, Leuba maintained, for the psychologists:

Detailed acquaintance with the orderliness of physical nature dispossessed God of that realm.<sup>[42]</sup> Will not familiarity with mental and social laws dispossess him of the psychic world also? . . . For the psychologist the mental life is as completely within the realm of law as the physical; therefore, if the existence of law is a bar to God’s action, he is excluded from intervening in the psychical life of man as well as in the physical universe. (1916, 240)

Here is Leuba’s sharpest clash with theology, both traditional and modern, for however much or little God may be seen as intervening in the physical world, it has been maintained with near unanimity that God can affect the human mind or heart and that humans have free will in responding to such divine psychic action.

Recognition of the reign of law may account for some cases of skepticism. Laplace’s nebular hypothesis, for example, seemed to some commentators at the time (some two centuries ago) to exclude God’s hand from the universe. However, many also came to see that, although God may not be needed to intervene in order to set the planets in their proper orbits around the sun (as Newton believed), the natural order of the solar system reveals an underlying regularity that reflects the lawfulness of God and the constancy of his will. Interestingly, Bryan rejected the nebular hypothesis but—in apparent opposition to Leuba’s expectation regarding recognition of the reign of law—asserted, “The reign of law, universal and eternal, compels belief in a Law Giver” (Bryan 1922, 13–14).

It is thus unclear how Leuba’s theory of “the recognition of deterministic law” explains the different belief levels of physicists and biologists. One might well think that, especially for the first two decades or so of the twentieth century, physicists would have been far more sympathetic to the idea

of a law-determined universe than biologists. For biologists, however, the appearance of design in organisms—their internal organization and adaptation to the external environment—is readily explained in terms of Darwinian variation and natural selection, processes that may appear random and contingent, not deterministic, or at least not solely deterministic.

Within traditional theology itself there is a general tension between determinism and contingency. If God is a benevolent, nonarbitrary, and divine lawgiver, the world God created must reflect something of the divine beneficence and order. But if the world is too ordered, too lawful, there is no room for miracle, for God's continued providential care and compassionate intervention. Darwinian evolution may seem to allow great scope for God's guiding hand, as many theistic evolutionists today proclaim. The apparent randomness and contingency within evolution, then, are hardly insurmountable obstacles to faith.

The traditional problem of suffering is underlined in evolutionary theory by the cruelties of natural selection. Leuba noted that the problem of evil or suffering has undermined the "ancient faith" of many (Leuba 1950, 73), but, unlike Bryan, he did not specifically link the growth of disbelief to awareness of evolutionary theory. However, given that the problem of suffering is more apparent in biology than in physics, one wonders to what extent issues of theodicy played a more critical role than recognition of the reign of law in the greater skepticism of Leuba's biologists.

Developments in the field of psychology in the early twentieth century such as Freud's discovery of the unconscious not only led to greater understanding of psychic processes but also tempted some psychologists, like Leuba, to assume that the thoughts and feelings of the human mind and heart were, in theory at least, as predictable as the orbits of the planets. Discoveries in other fields, perhaps most of all in physics, undermined confidence in any such deterministic notions. With the development of quantum mechanics, especially the principle of uncertainty in the 1920s, Leuba's confidence in the universality of deterministic law and his derivative theory of "the recognition of deterministic law" were bound to appear naïve to later generations. Recent developments in chaos theory only serve to emphasize the futility of attempts to predict the behavior of complex systems, from the weather to the human mind.

*Leuba's Predictions regarding Trends in the Religious Beliefs of Scientists.* In light of the actual figures that Larson and Witham report in comparing the results of their surveys of scientists with Leuba's, their declaration of the failure of Leuba's prediction regarding an increase in disbelief among scientists as education spread is somewhat puzzling. Leuba's expectations regarding an increase in disbelief among scientists seem generally fulfilled in three out of four categories. Belief in immortality has decreased for both the lesser and greater scientists, and belief in God has decreased among

the eminent ones. Only belief in God among lesser scientists has apparently remained steady (indeed, must actually have risen, to counterbalance the decrease in belief among the greater scientists). Regarding greater scientists, Larson and Witham note the likely different selection bias in the two samples, yet they still conclude that a comparison of the two surveys of top scientists reveals a “rate of belief lower than ever” (1998, 313).

Even if one accepts Larson and Witham’s conclusion that scientists are “still keeping the faith,” we must look at Leuba’s prediction more carefully. Leuba’s prediction was based on the assumption that there would be increasing levels of education nationwide, which included for him the fostering of intellectual independence. Far less assured was his sense that such a development would occur quickly.

The reception of his 1916 book among fellow academics certainly gave Leuba reason to question any easy assumptions he may have had about the decline of traditional religious belief among intellectuals. As he stated in the preface to the second edition of his work, with reference to a number of reviews of the first edition, “they indicate with some precision how far we are from having achieved the degree of intellectual freedom on which we commonly pride ourselves. Even among men devoted to the advancement of science, the weight of tradition remains a powerful hindrance to the quest and the diffusion of religious knowledge” (Leuba 1921, xiii).<sup>43</sup>

In the conclusion to the first edition, Leuba had emphasized the importance for scientific progress of a climate of intellectual freedom, both in early family life and later in the working environment of scientists. For Leuba, any failure for scientists as a whole to become more disbelieving would be due, in part, to the general failure of familial, social, political, and educational institutions to encourage intellectual freedom. As Massimo Pigliucci remonstrated in response to Larson and Witham’s 1997 *Nature* article,

I feel justified in reversing Larson and Witham’s interpretation of the results. Instead of concluding that scientists are “keeping the faith” . . . , I would suggest that the two surveys [Leuba’s, and Larson and Witham’s] dramatically point to a general failure of our educational system. We are not becoming more educated, we are simply acquiring more *knowledge*. There is a fundamental difference between the two. (Pigliucci 1998, 68)

A further complication in interpreting Larson and Witham’s reports arises from consideration of the second survey conducted by Leuba in 1933. This follow-up study repeated his 1914 investigations, except that historians were no longer included.<sup>44</sup> Tables 6 and 7 compare the results of his two surveys. Regarding belief in God, Leuba concluded, “A marked increase in unbelief during the last two decades is thus recorded” (1934, 297). And regarding belief in immortality: “In every group, without exception, the figures for 1933 are considerably smaller than those for 1914” (p. 297). His two surveys appear to indicate, then, that over the course of

two decades the belief rate of the lesser “physical scientists” fell 14 percent for belief in God and 17 percent for belief in immortality, the belief rate of the greater by 50 percent in both categories. For the more skeptical and disbelieving lesser “biological scientists,” the drops were 20 and 29 percent; for the greater, 28 and 40 percent.

Larson and Witham, in their 1998 letter to *Nature*, noted the substantial loss of belief indicated in Leuba’s 1933 survey (1998, 313) but refrained from commenting on its implications. In a 1999 *Scientific American* article, Larson and Witham again referred to the 1933 survey but mainly with reference to the results regarding the greater scientists. The summary heading following the title of their *Scientific American* article proclaims that their survey “suggests that scientists’ beliefs have changed little since the 1930s.” It would seem, however, that an explanation is needed for the apparent decline of religious belief among the less eminent between 1914 and 1933 and for the apparent *resurgence* of belief among this same group since 1933.<sup>45</sup> In any case, there are major problems in comparability between Leuba’s earlier surveys and Larson and Witham’s, given the problem of specific disciplines included and other factors such as the changing composition of American scientists, especially the increasing presence of women, who as a group are somewhat more conservative or believing than men.

TABLE 6  
The Believers in God

	Lesser Scientists		Greater Scientists	
	1914	1933	1914	1933
Physicists	50	43	34	17
Biologists	39	31	17	12
Sociologists	29	30	19	13
Psychologists	32	13	13	12

TABLE 7  
The Believers in Immortality

	Lesser Scientists		Greater Scientists	
	1914	1933	1914	1933
Physicists	57	46	40	20
Biologists	45	32	25	15
Sociologists	52	31	27	10
Psychologists	27	12	9	2

*Leuba's Predictions regarding Trends in the Religious Beliefs of the American Public.* Larson and Witham in their 1997 *Nature* article argued that Leuba's predictions regarding the fate of Christianity's two cardinal beliefs in society at large as scientific knowledge spread were not fulfilled and that Leuba had "misjudged either the human mind or the ability of science to satisfy all human needs" (p. 435). It should be noted at once that while the two cardinal beliefs held a high level of assent in American society at the end of the twentieth century (see what follows), we have no comparable data from the early part of the century to tell us whether belief levels may have been even higher. Leuba remarked near the end of his life, "I have been concerned with the beliefs of intellectually superior people. . . . I have no statistical knowledge to offer for the population in general" (1950, 24).<sup>46</sup>

One may note here, however, that in his posthumously published book, *The Reformation of the Churches* (1950), Leuba included the results of surveys he conducted in 1935 of bankers, business people, lawyers, and writers, selected from the 1934–35 edition of *Who's Who in America*. Interestingly and perhaps not surprisingly, bankers were the most likely to be believers in God (64 percent), while writers (including dramatists and playwrights) were least likely (32 percent) (1950, 52). Writers were thus about as skeptical as biological scientists and sociologists in the mid-thirties (see Table 6). It is clear that recent attention to Leuba's studies has been sparked by the renewed interest in the science-religion debates. Leuba's focus was broader, extending to the leaders of society in various scientific, financial, artistic, and other pursuits.

Despite the general lack of data regarding popular belief levels in Leuba's day, he surmised that fifty years prior to his own 1916 study (that is, in the 1870s or so) the responses to the questionnaire given to his college students would have been uniformly conforming to traditional catechisms (1916, 185). One reviewer of Leuba's study, Alfred Lane, expressed shock at such supposed historical blindness, referring to the lack of orthodoxy in "the age of Huxley and Tyndall" (Lane 1917, 621). Leuba responded that the stir over Darwin's theory, championed by Thomas Huxley and John Tyndall, did "not necessarily correspond to the number of disbelievers in God and immortality" (Leuba 1917, 629). Nor, one may note, was the situation in America the same as in Britain. Although consistently high belief levels for the 1800s and early 1900s in America remain largely a matter of speculation, it is clear that among Leuba's surveyed students there was no such uniformly high level.

Perhaps Leuba's college students stood somewhere between the scientists and intellectuals on one hand and the general public on the other, a conclusion that would be compatible with Leuba's own hypotheses.<sup>47</sup> Lane, however, wondered whether the "savants [greater scientists] are not like ordinary men" and even suggested that there might be "a large excess of



believers among the minor men” (1917, 622–23). Larson and Witham’s ziggurat model suggests otherwise.

Recent studies have shown that church membership, adherence, or affiliation in America has actually grown at a steady pace since the Revolution. Nonetheless, as Roger Finke and Rodney Stark note regarding the colonial era, “The lack of affiliation does not necessarily mean that most were irreligious” (1992, 22–23). Conversely, affiliation may not be a good indicator of deep religious commitment. Only for the last sixty years or so do we begin to get reliable statistics for levels of belief among the general American public (Beckwith 1981, 12).

The statistics for the last six or seven decades regarding American belief in God (defined in a general sense—not necessarily limited to a God who answers prayers) are ambiguous with regard to Leuba’s expectations. From the mid-1930s to the late 1980s, according to George Gallup Jr. and Sarah Jones, American belief in God or a universal spirit remained stable at about 94 percent (1989, 2). Gallup and D. Michael Lindsay report similar statistics from 1944 to 1997 for belief in God or a Higher Power (1999, 25). Yet one must look at the statistics carefully. For instance, Gallup reports that 79 percent “know God really exists and . . . have no doubts about it” (Gallup and T. Jones 2000, 187) but that only 64 percent believe in God without any doubts (Gallup and Lindsay 1999, 24).

Further, a 1996 poll, cited by both Shermer (2000, 22) and Larson and Witham (1997, 436), points to the current diversity of Americans’ notions regarding God. According to this survey, as summarized by Shermer, “30 percent of believers described ‘God’ as a deity other than the biblical god: 11 percent saw God as a higher consciousness; 8 percent said God is the total realization of personal human potential; 3 percent voiced a belief in many gods each with his or her own power and authority, and 3 percent reported that everyone is his or her own god.”

As for the specific, traditional notion of a God who answers prayers, a 1986 Gallup survey, while confirming the stable 94 percent of Americans believing in God or a universal spirit, found that only 84 percent believed in a God who can be reached by prayer (Gallup and S. Jones 1989, 4–5). In a more recent survey conducted by Goldhaber Research Associates, 88.6 percent of Americans believe in a personal God who can answer prayer (Tonne 1996, 34). And a 1997 *Newsweek* article, “Is God Listening?” reports that “87 percent [of adult Americans] say they believe that God answers their prayers at least some of the time” (Woodward 1997, 58). What would similar polls have found eighty-plus years ago?

Surveys over the last six decades regarding belief in immortality reveal a somewhat similar stability, although at a lower level of belief and with more ups and downs—from 76 percent to 67 percent, between 1944 and 1997 (Gallup and S. Jones 1989, 16; Greeley 1989, 14; Gallup and Lindsay 1999, 28). Again, it would be interesting to know what polls in 1914 would have shown.

One also wonders whether Leuba asked the most revealing questions. What if he had asked, "How important is religion in your life?" Polls asking that question for the last half century report that in 1952, 75 percent of American adults said "very important," and only 5 percent responded "not very important." In 1988 only 53 percent answered "very important," while the "not very important" respondents had risen to 15 percent (Gallup and S. Jones 1989, 208). Regarding morality, as we shall see, Leuba called for a new spiritual foundation for ethics, one based on an understanding that "moral values come into existence in social relationship, as a natural and inevitable consequence of the nature of man" (1921, xx). What if Leuba had asked, "Should morality and ethics be based more on traditional religious values, or more on man's experience over the centuries?" A poll in 1987 revealed that 43 percent of Americans responded with "traditional religious values," while 44 percent answered with "man's experience over the centuries"—9 per cent answered both (Gallup and S. Jones 1989, 100–101). And what if Leuba had asked, "Do you believe that religion can answer all or most of today's problems or that religion is largely old-fashioned and out of date?" In 1957, 81 percent responded that religion "can answer" today's problems, and 7 per cent thought that religion was "out of date." In 1988, the former group had declined to 57 percent, while the latter had risen to 20 percent (Gallup and S. Jones 1989, 212–13).

*Leuba's Predictions regarding a New Religious Epoch.* Leuba would never have asked the questions just cited in the form employed by the pollsters, for they make no distinction between traditional religion and what Leuba called humanist religion. In *The Reformation of the Churches*, Leuba portrayed himself as no enemy of religion, even sharing the aims of traditional religion—"the welfare of humanity"—while rejecting their supernatural means (1950, 6). He strove to show how "incontrovertible facts . . . can give to life a religious value and make it worthy of our best endeavors" (1950, 126). Perhaps the most neglected aspect of Leuba's predictions concerns his notion of a possible new phase in religious history in which religious worldviews will be reconstructed in harmony with, or at least not in opposition to, the findings of modern science.

In the preface to the 1921 second edition of *The Belief in God and Immortality*, Leuba made clear that he did not expect the decline of religion as such (among American scientists or the American general public) but only a decline in Christianity's two fundamental beliefs—belief in a personal God who responds to prayer, and belief in personal immortality. Leuba noted that if such beliefs did indeed decline, as his data suggested, "It would usher in a new epoch in the religious history of mankind" (1921, xvii). In his 1950 book (largely composed in the late 1930s and early 1940s), he stressed that he did not expect "a rapid transformation of all the

churches of the land. Fundamentalist churches are far from having been outgrown by all the people; that religious rear guard will remain with us for a long while. Intellectual and moral progress is distressingly slow” (pp. 13–14).

Leuba spoke of two conditions necessary for this religious reformation. First, there must be “a sufficiently widespread realization that the crumbling religious structures in which we are still dwelling have ceased to keep us spiritually warm” (1921, xx). Second, there must arise the broad conviction that the primary source of moral values is not the supernaturalistic God of traditional belief but rather is the very nature of humans as social beings. In Leuba’s view, such a reconstruction had already begun in his day: “An increasing number of religious leaders . . . are as a matter of fact endeavoring to formulate a religion in which the traditional Christian God is exchanged for a God-belief in agreement with present knowledge” (1921, xvii–xviii). He concluded that disbelief in the traditional God does *not* imply some sort of materialistic philosophy: “On the contrary, many if not most of them [the disbelievers] have exchanged the traditional God for forms of spiritual belief possessing a higher ethical significance” (1921, xxi).<sup>48</sup>

The notion that the only alternative to traditional belief is materialism, according to Leuba in his *The Reformation of the Churches*, was one of the major reasons for the slow emergence of modern churches dedicated to his ideal of religious humanism.<sup>49</sup> In addition to the association of materialism with evil, Leuba pointed to the lack of worldly prestige of the emerging humanist churches (for example, the Unitarians and Ethical Cultures Societies) and the public ignorance of their value to society as other reasons for their slow growth (1950, 200–201).

Reliance on dry public addresses and the absence of ritual and pageantry in the emerging churches was yet another reason Leuba cited, noting that “Man is a very complex being; he cannot be at his best unless satisfaction be given to all his legitimate needs” (1950, 123). While deploring supplication to supernatural beings, Leuba praised many aspects of traditional worship: “Feelings of awe before greatness and power, of admiration before the beautiful, of reverence before the good, of gratitude for service rendered, are not only legitimate but morally healthful reactions” (1950, 104). He called upon artists and philosophers, as well as scientists, to participate in the reformation of the churches, and even extolled the Roman Catholic Church for its “empirical wisdom” in knowing how to make use of music, images, architecture, pageantry, and rite to motivate the human will and guide the emotions (1950, 124). Leuba’s own recommendations for spiritual growth among members of the new churches included “self-examination and confession,” “hallowing the main events of life,” and the practice of relaxation and “receptive quietude” in which “the mind is recentered about the larger ends of life” (p. 184).

Leuba also realized that belief in the traditional God assures the believer that life is more than simply a meaningless accident. He accepted that for a worldview to satisfy the needs of the human heart, we must be able to see that such ideals as “truth, justice, mercy, love . . . [are] more than accidental and vanishing products of a chance evolution” (1950, 132). Rejecting the notion that evolution was blind and purposeless—a view espoused by both opponents and some proponents of the theory—Leuba argued that “in addition to the traits generated by the blind, mechanical force described by Julian Huxley, there is in man an urge of an intelligent and spiritual nature. It is not created by man; it is transhuman, since it is already present in animals. It is a part of the cosmic forces sustaining and directing the evolutionary processes.” He further described this urge as “a manifestation of a creative force connecting humanity vitally and hopefully with the universe” (1950, 141–42). Bordering on the mystical, Leuba affirmed that this “mysterious cosmic trend manifested in us” impels us to better ourselves and our environment, both “physically and spiritually, and thus [to approach] an invisible consummation” (p. 186). Even the end of the world as predicted by astronomers cannot quench this “urge to perfection,” for it may yet arise in some other entirely new form of existence (p. 142).

Clearly for Leuba religion and science need no longer be at war with each other. Both enterprises share “devotion to the public good, . . . the search for truth, . . . awe before the mystery of life” (1950, 9). Leuba’s emphasis on the ethical dimension of the religious reconstruction he anticipated and his awareness of the role of ritual and spiritual practice in human life and of the need to avoid a cold materialist philosophy point to his clear recognition that science does *not* satisfy *all* human needs. Nor would Leuba have been satisfied with the model of religion and science that Gould refers to as “nonoverlapping magisteria” (Gould 1997). Leuba’s notion of a mystical-evolutionary cosmic urge, whatever its philosophical and scientific problems, invites a call to dialogue, if not actual synthesis, between science and religion.

Reviews of *The Reformation of the Churches* both praised its courageous challenge to orthodoxy—a review in the *New York Times* called it “a body blow at traditional complacency” (Anon. 1950, 31)—and condemned Leuba’s “naïve naturalism of the ethical-culture-humanist variety” (Kean 1951, 222). The *Times* review excused Leuba’s faith in the infallibility of science because he had written “before the implications of the atomic era were apparent.” Others rejected his call for a new rational spirituality as yielding only “the same thin and arid religion which the seventeenth century brought” (Norris 1950, 224) and chided him for his ignorance or neglect of developments in liberal theology (Bond 1950, 347). Yet Leuba may have been more aware of the challenge of fundamentalism than some of his liberal critics. Other reviewers were more neutral, intrigued by Leuba’s

call to leave superstition behind but not the aesthetic power of ritual (Smith 1950, 89). A few criticized his use of out-of-date data, while others argued that “there is no sufficient reason to doubt that they [the surveys] correctly indicate the trend in this generation” (Johnson 1950, 81).

One of the most common critiques concerned Leuba’s use of questionnaires, “at best fallible instruments, especially in securing beliefs of people” (Fairbanks 1953, 51). Such criticisms had dogged Leuba ever since the publication of his 1916 book, *The Belief in God and Immortality*—as a 1917 reviewer of that book asserted: “There are few subjects as to which statistics can be more meaningless” (Anon. 1917, 316). Today we can safely say that there are few insights of Leuba more accepted than his trust in the meaningfulness of conducting polls on religious beliefs, however problematic some of his own methods may have been. Just ask Gallup, or for that matter, Larson and Witham.

At the beginning of the twenty-first century, we observe a large number of theologians, often with scientific credentials such as Arthur Peacocke<sup>50</sup> and John Polkinghorne,<sup>51</sup> who are seriously engaged in reconstructing theology in a way that accords with modern science. That such reconstructions do not dismiss a God who acts within the physical universe is in part due to developments within science itself (such as quantum uncertainty and chaos theory) that undermined the deterministic conception of the natural (and even social) world that Leuba had assumed. At the same time, these reconstructions often affirm that God’s actions do *not* interfere with natural causation and that God’s activity is *not* discernible from a purely naturalistic perspective. Further, there are those theologians who do away altogether with traditional notions of a God who answers prayers. As Harvard theologian Gordon Kaufman expresses it, as quoted in *Newsweek*, “It’s not very helpful to think of God as an old man in the sky waiting for communication and answering it.” For Kaufman, the only sort of praying that makes sense anymore is “meditation—trying to understand faults, mistakes, where I’ve gone wrong” (quoted in Woodward 1997, 60). The theological reconstructions of such intellectuals as Peacocke, Polkinghorne, and Kaufman suggest that Leuba’s predictions regarding a new religious epoch may be in the process of at least partial fulfillment at the top academic levels. Whether, or when, there will be a significant infiltration of such ideas from the academic elite into popular piety remains to be seen.<sup>52</sup>

In conclusion, I wish to emphasize one final insight of Leuba’s: that the religion-science encounter is only one part of a broader cultural development. Recent accounts of Leuba’s studies often focus exclusively on the religion-science issues and may thereby distort comparison of his surveys with contemporary surveys. This point is clearly demonstrated, for instance, by the changes made by Larson and Witham in the introductory statement of their questionnaire. Leuba had begun the instructions to his

respondents with the following: “Conflicting statements are confidently made regarding the prevalence among civilized Christian nations of the belief in God and in Personal Immortality.” Larson and Witham’s questionnaire begins: “Conflicting statements are confidently made regarding (whether scientists hold a) belief in God and in personal immortality.” Within Leuba’s broader framework, one is invited, even compelled, to ask why his dramatists and playwrights—included among the “writers” of his 1935 survey of men of affairs—were just as disbelieving as the skeptical biologists and sociologists.

## NOTES

1. Larson and Witham tend to dismiss the significance of the decrease in belief in immortality. They comment that in Leuba’s survey about 20 percent of scientists who did not believe in God nonetheless believed in immortality, while they “obtained a more logical response in that belief in God and in immortality were almost always held together.” They apparently ascribe the “less logical” response in Leuba’s survey to his alleged lack of clarity regarding what was meant by immortality, suggesting that “it might have meant the conservation of energy or . . . being remembered by later generations.” They refer to the “simple” format of Leuba’s questions but apparently overlook Leuba’s qualifying definition immediately preceding the survey question and reproduced in the questionnaire that accompanies Larson and Witham’s article. Leuba’s qualifying phrase defines immortality as “the belief in continuation of the person after death in another world.”

2. Leuba himself used the term *nonbeliever* to refer to the entire group of disbelievers, agnostics, and doubters (1916, 250). The category of “agnostics and doubters” is itself rather problematic. Leuba used two survey forms, with different wordings, in his 1914 study. The first form allowed respondents the option to affirm or deny the statement “I am an agnostic.” The second form replaced this option with “I have no definite belief regarding this question.” Larson and Witham, on their survey, used the second wording but refer to “doubters/agnostics,” thus conflating the two forms, as Leuba also did.

3. Larson and Witham give the percentage of disbelievers at 77.9.

4. Again, Larson and Witham report the percentage of disbelievers at 69.5. For ease of comparison with the mathematicians, I use percentage of believers in all three instances. Larson and Witham do not give the percentage of disbelievers among 1996 biologists.

5. From the chart that Larson and Witham include with their letter, the “nearly 70 percent” nonbelief figure for greater scientists would appear to be more precisely 73.6 percent (adding the chart’s 52.7 percent for disbelievers, plus its 20.9 percent for doubters/agnostics). But the belief figure in the chart is given as 27.7 percent, thereby adding up to 101.3 percent. Leuba states that the belief figure for “greater” scientists is 31.6 percent (thus nonbelievers constitute 68.4 percent, a figure in line with Larson and Witham’s “nearly 70 percent”) (1916, 250).

6. Larson and Witham’s dating of Leuba’s work is slightly confusing. In their *Nature* commentary, they state that Leuba conducted his survey in 1916, when in fact that was the date of publication of his book *The Belief in God and Immortality*, in which he reported his survey findings conducted two years earlier in 1914 (correctly acknowledged in Larson and Witham’s 1998 letter). Leuba’s second survey, conducted “twenty years later” according to Larson and Witham, was carried out in 1933, and published in *Harper’s Magazine* in 1934.

7. Michael Shermer, typical of many reporters of Larson and Witham’s articles, misstates their summary of Leuba’s findings regarding the more eminent scientists: “Leuba discovered that disbelief in God rose from 60 percent among the general scientific population, to 67 percent and 85 percent in two different samples among these ‘greater’ scientists (defined as members of the National Academy of Sciences . . .)” (2000, 73). Shermer gives no indication that the two main samplings belong to Leuba’s 1914 and 1933 surveys. Then he attributes the 67 percent figure to one of two samples of greater scientists, rather than to the general scientific population of 1933 as reported by Larson and Witham. Finally, he defines the greater scientists as “members of the National Academy of Sciences,” an accurate description of Larson and Witham’s greater scientists

but not of Leuba's (further down on the page, Shermer does correctly define Leuba's greater scientists).

8. As I discuss in more detail below, Leuba selected his scientists from J. McKeen Cattell's *American Men of Science: A Biographical Directory* (1910 edition). In early editions of the *Directory*, an asterisk appeared beside the field of expertise for those scientists whose work was considered "most important." Leuba constructed his list of greater scientists from the asterisked entries. Because the *Directory* no longer makes such designations, Larson and Witham took for their more eminent scientists members of the National Academy of Sciences—a more elite group, as Larson and Witham point out.

9. As stated in note 5, Leuba reports 31.6 percent for believers, rather than 27.7 percent.

10. I am not sure where Larson and Witham obtained this 15 percent figure. Leuba reports figures for greater "biologists" and "physicists" of 12 percent and 17 percent, respectively (1934, 297). The 15 percent thus may be an averaging of these two figures.

11. On the same day as Wheeler's article appeared, Witham reported in the *Washington Times* on a parallel study of his and Larson's regarding evolution and God, in which the same scientists were polled but with physicians replacing the physicists. The article was reprinted, with the same apparent typographical error, in *Reports of the National Center for Science Education* (1997, 33).

12. Larson and Witham's two *Nature* articles provoked a tremendous response in the media and elsewhere. All reviewers I found who referred to the professions polled simply repeated Larson and Witham's claims, sometimes rather loosely. Thus, a critique in the *Free Inquiry* (Cherry, Flynn, Madigan, and Szalanski 1997) that pointed to possible errors in the Larson and Witham study nonetheless repeated their claim: "They, too, polled 1,000 biologists, mathematicians, astronomers, and physicists drawn from a current edition of the same reference work Leuba had used." In a "News and Comment" essay appearing in *Science*, Gregg Easterbrook wrote, "The results of Larson's [1996] poll, in which nearly 40% identified themselves as believers, almost exactly matched those of a similar poll conducted in 1916" (1997, 892). Earlier in the essay, Easterbrook had reported that Larson's 1996 poll revealed "that about 40% of working physicists and biologists hold strong spiritual beliefs" (p. 890).

13. See Larson and Witham 1997, 435; Larson 1997, 40–41; cf. Leuba 1921, xxii–xxiii, where he discusses the reception of the first edition of his book, particularly in religious and theological journals. Leuba notes the relative silence in popular magazines and scientific journals regarding his findings. Apparently it was Bryan's use of Leuba's data in the early 1920s that helped create the "scandal." See Klein 1997, 10.

14. Leuba also tried to survey philosophers but found that they had so much trouble with the meaning of the survey questions, and particularly with the term *God*, that their responses were unusable. Leuba provides the numbers of intellectuals surveyed in the different groups on pages 222, 259, 263, and 267 of his 1916 study.

15. With reference to Leuba's eminent biological and physical scientists, Larson and Witham report that "Leuba obtained a return rate of about 70% in 1914 and more than 75% in 1933" (1998, 313). Leuba does report the "more than 75%" figure for his 1933 study (1934, 293), but, as already indicated, he reports the same figure, not 70 percent, for the 1914 study as well. Leuba reports these return rates for all questionnaires sent to scientists. Klein (1997) also misreports the 70 percent response rate for Leuba's 1914 study, apparently relying on Larson and Witham.

16. In his 1934 article Leuba tells us that, for his 1914 investigation, "The edition of 1906 of *American Men of Science* (then the most recent one) was used" (1934, 297). Leuba seems to have misremembered his own procedures. On one hand, in 1914 the 1910 (second) edition would have been the most recent; on the other, Leuba himself tells us in his 1916 account of his study (p. 221) that he used Cattell's directory "containing about fifty-five hundred names," a figure that applies to the 1910 edition but not to the 1906, with only 4,000 "scientists" plus 131 other intellectuals in philosophy, education, economics, and sociology (the second edition, p. 538, provides the latter statistics). Others have also had a difficult time correctly assigning the edition that Leuba used. Robert Wuthnow (1985, 188) says that Leuba used the 1913–1914 edition, an edition that does not exist (the third edition was delayed until 1921 because of the war).

17. Regarding the first 500, Leuba also notes that "a few psychologists, sociologists, and educators got into this division. This was not intended" (1916, 251n). He goes on to say that, in Division II, "physical and biological scientists only were included," but he gives no indication of how he eliminated or replaced the psychologists, sociologists, and educators. Of course, Leuba did want to study psychologists and sociologists, but he obtained their names primarily from professional membership lists, not from Cattell's *Directory*.

18. For Division I the basic question regarding a personal God, to be affirmed or denied, was "I believe in a God in intellectual and affective communication with man, I mean a God to whom one may pray in the expectation of receiving an answer. By 'answer,' I do not mean the subjective, psychological effect of prayer" (1916, 224–25). The basic question sent to Division II scientists was "I believe in a God to whom one may pray in the expectation of receiving an answer. By 'answer,' I mean more than the subjective, psychological effect of prayer" (1916, 225). A follow-up question, the same for both divisions, stated, "I do not believe in a God as defined above." But the third and final question again differed. For Division I it was "I am an agnostic," and for Division II "I have no definite belief regarding this question." There were also changes in the questions regarding immortality. The wording of Leuba's survey questions is clearly problematic, as he himself recognized. For a discussion of these problems, see Scott 1998, 24–25.

19. This procedure is specified on pages 565–66 of Cattell's 1910 *Directory* and is the same procedure used in his first, 1906, edition (see the preface to the first edition, reprinted on page vi of the 1910 edition). Leuba incorrectly states that twelve (instead of ten) leading men in each field chose the greater scientists (1916, 249n; repeated in 1934, 296), apparently confusing the number of judges in each field with the number of fields.

20. As for his method of distinguishing between the two fields, Leuba tells us, "The answers from the physical scientists were kept distinct from those of the biologists by a difference in the printing of the Q[uestionnaire]" (1916, 249n).

21. For the first division, the less eminent were chosen "by taking the first name on every other page" of the *Directory*, plus "the last name on every fifteenth page" in order to achieve the desired number of 300. If an asterisked, or starred, name was encountered, "the first unstarred name following, or preceding was taken instead." For the 200 eminent scientists, he took "every fifth starred name in the volume." For the second division, the lesser men were selected "by taking the second name on every other page, and the name before the last on every fifteenth page." If a starred name, or a name already used for Division I, was encountered, "it was replaced by the nearest available name." The greater men were chosen for Division II "by taking every fifth starred name, beginning at the end of the volume." Such procedures would hardly be considered random today.

22. Thus, regarding belief in God, as Table 5 indicates, there was a 5.5 and an 8 percentage point decrease in belief levels for lesser and greater scientists, respectively, in Division II compared to Division I. For belief in immortality, the decrease was 13.7 and 3.6, respectively (Leuba 1916, 253). Leuba's discussion of the two questionnaire forms (1916, 226) notes an obvious logical change regarding one of the subquestions relating to immortality, but he is rather nonchalant about the possibility of more subtle changes in response that may have been evoked by the different wordings. Although the percentage differences are on the borderline of being statistically significant, there is clearly reason to wonder about the effects of the change in wording.

23. See note 21. Especially regarding the lesser men, it is not explicit whether "every other page" means odd or even pages. Nor is it entirely clear when Leuba chose a following or a preceding name to avoid selecting a starred name, especially when at times two or three starred names appeared before and/or after the first name (or the second name, in the case of Division II) on the page.

24. Occasionally the *Directory* lists two or more disciplines for a given scientist; I took the first listed. See the 1910 *Directory* (Cattell 1910, 543), for a tabulation of such double listings for greater men in the 1906 edition. Cattell notes that about one-tenth of these greater men contributed to two or more disciplines.

25. Obviously, in many cases, judgment calls were necessary. My favorite example is my classification of Abbott Thayer (page 467, second name following a starred name) as a zoologist. His discipline is listed in the *Directory* as "painting." His contribution to science (and thus the rationale for his inclusion in the *Directory*) is his work on animal camouflage, or "Protective coloration of the animal kingdom," as the *Directory* describes it.

26. This can be deduced from the two tables on page 1264 of the fifth edition. The first table presents the distribution of scientists in all fields, applied and fundamental (but not specifically including anatomy, pathology, and physiology; these are placed under medical sciences). The second table presents the distribution in the fundamental sciences only, including anatomy, pathology, and physiology. The 1910 edition, incidentally, notes the inclusion of engineers under physics and of physicians under pathology (Cattell 1910, 538n).

27. A clear distinction between the physical and biological sciences in such areas as biochemistry and biophysics is increasingly difficult to maintain today, and even in Leuba's day it must



have been problematic to know how to classify such entries in the *Directory* as “biological chemistry” or “paleontology” (the discipline of many petroleum geologists) and such vague entries as “natural history.” Leuba’s inclusion of applied scientists is made clear in the list of occupations for the scientists he surveyed, which included “Government Service,” “Industry,” and “Physicians and Surgeons” (1916, 251).

28. When my data are averaged to provide an overall proportion of a given discipline (e.g., all astronomers, greater and lesser) relative to the total number of scientists in all of the included disciplines, the percentage figures correlate very well (within 2 or 3 percentage points in almost all cases) with the proportions for these disciplines given by Cattell for the first (1906) *Directory*. Cattell in his 1910 edition lists the total number of scientists and of greater scientists in each of the twelve fundamental sciences for the 1906 edition (1910, 538–39). From these data, eliminating such groups as the psychologists and anthropologists and making a few other adjustments, one can calculate the figures corresponding to my categories. A comparison of the figures reveals close agreement for both individual disciplines and the two general fields. Such correspondence suggests that the composition of the scientific community had not significantly changed between the 1903 survey (published in 1906) and the 1910 survey, and that my distribution of scientists among the disciplines is generally representative of the whole.

29. It should be recalled, however, that the scientists making the selections belonged to the twelve fundamental sciences. Thus, apparently no engineers, for example, were involved in choosing the greater scientists, a factor that might account for some of the underrepresentation of the applied sciences among the elite.

30. In the chart, the figures given for the occupations of scientists in the two fields for Division I, when added up, indicate that there were 303 physical and mathematical scientists and 163 biological scientists. These figures, according to Leuba, were generally representative of Division II as well.

31. One exception is Gerald R. Bergman’s article (1996) summarizing the surveys of scientists’ religious beliefs carried out in the twentieth century. Leuba, incidentally, also conducted surveys in 1935 of the religious beliefs of bankers, business people, lawyers, and writers, discussed below.

32. Leuba provided a summary graph for the data I provide in Tables 2 and 3 (1916, 278). The order of the five groups follows that of Leuba’s graph. Leuba also presented a number of charts and discussions of his data that provide more precise figures. Only the 40 percent figure for lesser and greater sociologists regarding immortality had to be estimated from the graph. Leuba also summarized his findings for four of the groups, excluding historians, in his later article, “Religious Beliefs of American Scientists” (1934, 297).

33. Leuba divided all groups into lesser and greater, but for the sociologists alone he made three subgroups: lesser professors, greater professors, and non-professors, consisting of 25, 23, and 149 names respectively.

34. My table combines information given in Leuba 1916 (pp. 250 and 253).

35. Leuba did not entirely dismiss the significance of knowledge and experience. In his 1934 *Harper’s Magazine* article, when arguing against the notion that human pride or arrogance is the chief cause of disbelief among intellectuals (and older college students), he asserted, “It will appear to most, I think, that superior knowledge, understanding, and experience constitute a much more likely explanation . . . of disbelief . . . than a blinding pride waxing together with mental ability” (1934, 300). He immediately went on to contend, however, that “there should be added to knowledge and experience another cause of disbelief,” namely, “independence of character,” without which new knowledge is relatively ineffective in transforming one’s outlook (Leuba 1917, 626–27).

36. Leuba’s historical view of the science-religion relationship was clearly one of warfare: “During the Renaissance, official Christianity did not stand as godfather to the newborn natural sciences; it was the open enemy of the new learning. Instead of encouraging, it persecuted the Brunos and Galileos” (1950, 107). However, the warfare model was not his notion of the *ideal* relationship, as we shall see.

37. These figures do not include a very small percentage of both men and women students who believe in both a personal and an impersonal God.

38. Leuba was certainly not free of the sexism of his times. While leaving the question open regarding the cause of women’s greater dependence, he immediately went on to state that the greater aversion of women to breaking with their social groups was “a manifestation or perhaps

rather an aspect of their greater tenderness and conscious weakness" and "an expression of their greater need of affection and of their clearer consciousness of dependence" (1916, 285).

39. Recall that there were a fair number of chemical engineers among the chemists in Leuba's survey. Various studies have found chemical engineers "more likely to be affiliated with the church than physicists, zoologists, and geologists" (Bergman 1996, 45).

40. While Leuba collected data from the questionnaires regarding the two fields only from Division II, he did note the occupation of the 500 scientists of Division I as selected from Cattell's *Directory*. From his chart listing the occupations of scientists of Division I (1916, 251), one can calculate the following proportions: lesser "biologists" constituted only 32.4 percent of the lesser scientists (including the lesser "physicists"), and greater "biologists" made up 38.9 percent of the greater class. It is not clear whether this difference of 6.5 percent applies also to Division II (Leuba merely notes that the statistics for Division I "may stand also, in a general way, for the second division" [1916, 251]).

41. Leuba writes, "When the student of the physical laws has come to accept determinism in the physical world, he may and often does keep for the less generally understood biological and sociological phenomena the traditional belief in divine intervention. The biologist and the sociologist, however, better acquainted with the natural causes of these phenomena than their brothers of the physical sciences, find it just as impossible to admit God's action in the biological and sociological domains as in the physical" (1916, 265).

42. In the 1921 edition Leuba softened the statement to "tends to dispossess God of that realm" (p. 239).

43. By "religious knowledge," Leuba meant an academic or scientific knowledge about the origin and nature of religious belief.

44. Edd Doerr has stated (1997, 4) that the 1933 survey used a different sampling method and thus cannot be compared with the 1914 survey. However, Leuba himself undertook the second survey in large part precisely to make such a comparison, and he states, "The investigation made in 1914 was carried out in the same way as that of 1933" (1934, 297).

45. Most reports on Larson and Witham's study reinforced the notion that the rate of religious belief among scientists over the last eighty years was relatively constant (for example, Klein 1997, 10).

46. Leuba did add, however, that unbelief or indifference seemed to be widespread in France (1950, 24).

47. This conclusion receives some support from Ronald Mayer's 1959 study of undergraduate science majors, graduate science students, and eminent scientists. Mayer in part replicated Leuba's study and added several questions and analyses of his own.

48. Cf. Leuba's comments in his 1934 article: after noting what he perceived as the diminished influence of the churches, he proposed, "In order to be again a vitalizing and controlling power in society, the religions will have to organize themselves not in contradiction with the best insight of the time. They will have to replace their specific method of seeking the welfare of humanity by appeal to, and reliance upon divine Beings, by methods free from a discredited supernaturalism" (p. 300).

49. See, for instance, Bryan 1922, especially pages 14–15, for this polarizing view.

50. See, for example, Peacocke's *Theology for a Scientific Age* (1993), especially pages 135–83.

51. See, for example, Polkinghorne's *Belief in God in an Age of Science* (1998), especially pages 48–75.

52. Cf. Finke and Stark (1992, 45): "It may be that secularization ensues whenever religion is placed within a formal academic setting, for scholars seem unable to resist attempting to clear up all logical ambiguities. Rather than celebrate mysteries, religious scholars often seek to create a belief system that is internally consistent. Finding that things do not fit exactly, they begin to prune and revise and redefine. Whether or not this corrosive effect of scholarship on religion is inevitable, that is what went on at Harvard and Yale, starting well before the Revolution."

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## APPENDIX

Table A-1 summarizes my findings for the disciplines of a “representative” portion of the lesser scientists in Cattell’s 1910 *Directory*. I selected the particular scientists following two different interpretations of Leuba’s own selection rules, using either odd or even pages of the *Directory*, respectively (plus the last name on every fifteenth page).<sup>\*</sup> Such a procedure provides a check on how representative the two lists (odd and even) are. (The total for Division I odd pages is 281 rather than 300—Leuba’s number—because I excluded psychology and sociology, for example, in order to compare with Division II, from which Leuba eliminated these disciplines. The total for Division I even pages, coincidentally, is also 281, again short of 300 as a result of the same exclusions.)

**TABLE A-1**  
**My Accounting of Lesser Scientists by Disciplines**  
**(for Division I Only, and Excluding Psychology, Philosophy,**  
**Sociology, and Education)**

Physical Sciences	Division I Odd Pages	Division I Even Pages
Astronomy	7	8
Chemistry	52	62
Engineering	38	30
Geology	19	35
Mathematics	19	23
Physics	22	24
<b>Total</b>	<b>157</b>	<b>182</b>
Biological Sciences	Division I Odd Pages	Division I Even Pages
Agriculture	19	10
Anatomy	4	3
Botany	24	18
Medicine	24	20
Pathology	6	4
Physiology	4	6
Zoology	43	38
<b>Total</b>	<b>124</b>	<b>99</b>

<sup>\*</sup> See note 21 for details of Leuba’s selection rules. I compiled data on lesser scientists for Division I only, as there seemed little point in repeating the procedures for Division II. My figures for the lesser scientists of Division I and Leuba’s are in the same general ballpark. Given the room for errors, both in applying Leuba’s vague instructions and in assigning scientists in such ambiguous disciplines as biochemistry, paleontology, and pharmacology to either the “physical” or “biological” field, I doubt any more accuracy or greater degree of agreement would have been attained by counting up the lesser scientists of Division II.

Table A-2 gives the results for the disciplines of a “representative” portion of the greater scientists in Cattell’s 1910 *Directory* according to Leuba’s Divisions I and II. (The total for Division I is 186 and for Division II is 184, rather than Leuba’s intended number of 200 each, because of the usual exclusions. Leuba claimed not to have included psychology and similar fields in Division II but without specifying any rules for substitutions. Accordingly, I simply excluded intellectuals from those fields, without attempting to make any replacements.)

**TABLE A-2**  
**My Accountings of Greater Scientists by Disciplines**  
**(for Divisions I and II, and Excluding Psychology, Philosophy,**  
**Sociology, and Education)**

Physical Sciences	Division I	Division II
Astronomy	7	9
Chemistry	30	29
Engineering	3	3
Geology	18	19
Mathematics	23	19
Physics	24	25
<b>Total</b>	<b>105</b>	<b>104</b>
Biological Sciences	Division I	Division II
Agriculture	0	4
Anatomy	6	8
Botany	25	18
Medicine	9	7
Pathology	5	7
Physiology	10	9
Zoology	26	27
<b>Total</b>	<b>81</b>	<b>80</b>