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ON A DISCOVERY ABOUT GÖDEL'S INCOMPLETENESS THEOREM

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Ever since René Taton came out in 1955 with his book *Causalités et accidents de la découverte scientifique*,[1] which quickly appeared in English as *Reason and Chance in Scientific Discovery*,[2] much interest has been shown in the nature and circumstances of scientific discoveries. In that now vast literature it has often been noted, for instance, that a discoverer does not always perceive the full meaning of what he had discovered. On occasion that literature contains a discussion of the fact that discoveries can also be resisted, which is, of course, one of the worst things that can happen in science. The first egregious case was provided by Galileo in reference to Kepler's laws. Then there came the notoriously long resistance to the wave theory of light. To discover such things belongs to the historian of science.

The history of physics during the twentieth century began with Planck's resistance for more than ten years to the notion that he had discovered the quantum of energy, or rather the fact that atoms absorb and emit energy in a discontinuous way.[3] Einstein did not wish to consider for years the growing evidence, theoretical and observational, of the expansion of the universe. About the recently deceased Thomas Gold, one of the first proponents, with F. Hoyle and H. Bondi, of the steady state theory, it was promi - nently recalled in the *Economist* (July 3, 2004, p. 73) that he resisted to the

[1] With the subtitle, *Illustrations de quelques étapes caractéristiques de l'évolution des sciences* (Paris: Masson).

[2] New York: Philosophical Library, 1957; then issued in paperback (New York: Science Editions, 1962).

[3] Many details about that resistance can be found in T.S. Kuhn's *Black-Body Theory and the Quantum Discontinuity 1894-1912* (Oxford: Clarendon Press, 1978). See also ch. 1 in my book, *Numbers Decide and Other Essays* (Pinckney, Mich.: Real View Books, 2003).

end the devastating blow dealt to that theory by the findings of COBE (Cosmic Background Explorer). It is another matter that the notion, according to which hydrogen atoms are popping up everywhere in cosmic spaces out of nothing, should not have been resisted as something that cannot be dealt with by the methods of physics. This is so because the 'nothing' and the process of coming into being out of nothing cannot be measured.

In all such cases of resistance various factors – psychological, sociological, and ideological – play a role. The first two factors have been extensively investigated, and at times to the point bordering on the tedious and the ridiculous. Some created the impression that in order to make a significant scientific discovery one has to be twenty-five or younger, or come from a working class family, or have a contempt for social conventions. Practically no attention has been given to the ideological factor, possibly because ideology is akin to religion and in this age of ours religion is considered to be a strictly private matter, if it is considered at all.

Yet ideology seems to have played an important role in the resistance by prominent physicists to perhaps the greatest discovery in the history of mathematical logic, or Kurt Gödel's formulation, in November 1930, of the theorem that any non-trivial set of arithmetic propositions has a built-in incompleteness. The incompleteness consists in the fact no such set can have its proof of consistency within itself. The bearing of that incompleteness on physical theory, which has to be heavily mathematical, should seem obvious.

Physicists had all the less reason to ignore Gödel's discovery, because it was published in *Monatshefte für Mathematik und Physik*,[4] a leading monthly which carried as many articles about the latest in mathematics as in physics. Yet, thirty-five years went by before attention was called to the bearing of Gödel's theorem on the formulation of a comprehensive physical theory. As long as Godel's theorem remains valid, the formulation of a final, or necessarily true physical theory should seem impossible. This is so because such a theory, whether it is called Unified Field Theory, or the Theory of Everything (TOE), also called M theory,[5] cannot have its proof of

[4] 'Ueber formal unentscheidbare Sätze der *Principia Mathematica* und verwandter Systeme I', Volume 38, 1931, pp. 173-198. or 'Formally undecidable propositions of *Principia Mathematica* and related Systems I'. The German original and its English translation are available on facing pages in *Kurt Godel: Collected Works. Volume I. Publications 1929-1936,* ed. S. Feferman (Oxford: Clarendon Press, 1986), pp. 144-95.

[5] The M stands for a variety of words, such as Master, Majestic, Mother, Magic, Mystery, Matrix. See B. Greene, *The Fabric of the Cosmos: Space, Time and the Future of Reality* (New York: Alfred A. Knopf, 2004), p. 379.

consistency within itself. Yet a necessarily true theory cannot lack the quality of inner consistency in its mathematical part.

When this line of reasoning appeared in my book *The Relevance of Physics*, published by the University of Chicago Press in 1966,[6] the TOE theory and the M theory were still in the future, but much had been spoken of a Unified Field Theory, mainly a brainchild of Einstein. The context of my reasoning, or discovery, relates to the first Part of *The Relevance of Physics*, where in three chapters I dealt with the three main types of physics that prevailed in Western intellectual history. Those three types are the organismic, the mechanistic and the mathematical. The first, in which the world was taken for a living organism, prevailed from Aristotle on until Copernicus, Galileo, and Newton. The second, or mechanistic physics, in which interactions among particles of matter were viewed as interaction among bits of machinery, dominated the thinking of physicists until the beginning of the 20th century.

From the early 20th century on the idea has gained ground that the physical world was ultimately a construct in numbers. Consequently, the mathematical perfection of physical theory has been increasingly taken for an index of the perfection of the physical theory itself. Indeed by the 1960s many physicists voiced the hope that a final form of physics, or a final formulation of fundamental particles, would soon be on hand. Many such hopeful expressions are quoted in chapter 3 of *The Relevance*, a chapter which has for its title, 'The World as a Construct in Numbers'. At the end of that chapter I argued that because of Gödel's theorem such hopes were without foundation.[7]

In none of the hundred or so reviews of *The Relevance* was attention called to that connection between Gödel's theorem and a perfect or necessarily true physical theory. And much the same is true of the reviews of still other four books of mine in which I set forth the same line of argument, prior to 2002. Among those books were my Gifford Lectures, *The Road of Science and the Ways to God*,[8] given at the University of Edinburgh in 1975 and 1976. After that I set forth the arguments in *Cosmos and Creator* (1980),[9] then in my Fremantle Lectures, *God and the Cosmologists*, given at

[6] Two more editions followed, the last by Scottish Academic Press (Edinburgh) 1992.

[7] *Ibid*., pp. 127-129.

[8] Chicago: University of Chicago Press, 1978. See pp. 253, 427, 453, and 456. This work was also published simultaneously by Scottish Academic Press, and brought out in paparback by both Presses in 1981.

[9] Edinburgh: Scottish Academic Press, 1980. See pp. 49-51.

Balliol College in 1989,[10] and finally in my Forwood Lectures, *Is there a Universe?*, given at the University of Liverpool in 1992.[11] I should also mention a paper I read at the Nobel Conference at Gustavus Adolphus College in Minnesota in 1976.[12] The five other members of the panel were Fred Hoyle, Steven Weinberg, Hilary Putnam, Victor Weisskopf, and Murray Gell-Mann. What happened there when I referred to Gödel's theorem I told in detail in a paper just published.[13] What I said in all these publications about the connection of Gödel's theorem and a perfect physical theory has been ignored with only one exception. In his book *Impossibility*, J.D. Barrow quoted some lines from my *The Relevance of Physics* and *Cosmos and Creator* and in both cases he misconstrued what I said.[14]

One may perhaps say that the persistent neglect of what I said over thirty years about Gödel's theorem and physics was not valid. But then one has to say the same about a paper which Prof. Stephen Hawking read at the centenary celebration of Dirac's birthday, held in the Centre of Mathematical Sciences at Cambridge University on July 23, 2002. The very title of his paper, 'Gödel and the End of Physics',[15] should have created enormous attention well beyond the world of physicists, and should have brought attention to Gödel's discovery made seventy-two years earlier. Nothing of

[10] Edinburgh: Scottish Academic Press, 1989. See pp. 84-110.

[11] Published by Liverpool University Press in 1995. See pp. 101 and 107.

[12] 'The Chaos of Scientific Cosmology', in D. Huff and O. Prewett (eds.), *The Nature of the Physical Universe: 1976 Nobel Conference* (New York: John Wiley, 1978), pp. 83-112. Published also in Italian translation, 'Il caos della cosmologia scientifica', in *Natura dell'universo fisico* (Torino: P. Boringhieri, 1981), pp. 88-114.

[13] See note 15 below. Following the presentation at the same conference by Murray Gell-Mann, who promised a two-thousand strong audience that within three months, or certainly within three years, he would come up with a final theory of fundamental particles, I reminded him of Gödel's theorem and of the consequent futility of his project. It was then that he first heard of Gödel. But two months later he gave a paper at the University of Chicago and stated that because of Gödel's theorem that final theory cannot be achieved. Only he failed to refer to the incident at the Nobel Conference.

[14] With the subtitle, *The Limits of Science and the Science of Limits* (New York: Oxford University Press). In neither case did I say that, as Barrow would have it, I see Gödel's theorem to be 'a fundamental barrier to understanding the Universe'. It is such a barrier only for those who want a 'final' understanding of the universe in terms of mathematical physics and cosmology.

[15] Made available on the Internet via 'ogg orbis', and discussed in my essay, 'A Late Awakening to Gödel in Physics', *Sensus communis* 5 (2004) 2-3, pp. 153-162, available also on my website, www.sljaki.com. The article just appeared in Hungarian translation in *Fizikai Szemle* (Budapest). An Italian translation is forthcoming.

this happened. Hawking's paper created no significant echo. Yet that paper of his was far more fundamental for physics than the paper he presented on July 21, 2004, at the 17th International Conference on General Relativity and Gravitation. This paper, in which Prof. Hawking reversed his long-standing opposition, with an eye on his theory of black holes, to the principle of time reversal, was announced in headlines all over the world. The headline in *The New York Times* was 'Those Fearsome Black Holes? Dr Hawking Says Never Mind'.[16]

But this paper is not about the history of debates about black holes but about reasons of a widespread resistance to what I have kept saying about Gödel's theorem and a perfect, or necessarily final physical theory. The basic resistance has distinctly ideological aspects, and this is all too obvious in Hawking's case. He had repeatedly stated his atheism and indeed boasted of it. Now for an atheist or materialist there can be only two final entities: either his own mind or the material universe. In the case of physicists (or cosmologists) who dream of a final theory, the final entity is usually their own mind. Let me begin with a remark Prof. Hawking made in 1976, when he retorted Einstein's words, 'God does not play dice', with the remark that 'God not only plays dice with the universe, but sometimes throws them where they cannot be seen'. Only some amateurs in theology would be impressed by such remarks, made either by Einstein or by Hawking. Both were atheists in their own ways, which in their cases too implies some consequences for their patterns of thinking.

Theology, or rather a hint about Hawking's pseudo-theological motivations, again surfaced when a brief discussion appeared in *The New Scientist* of Hawking's paper, 'Gödel and the End of Physics', though only almost a year after its presentation. On the cover of the April 5, 2003, issue of *The New Scientist,* one could read the double caption, 'The Mind of God' and 'Hawking's Epiphany', of which at least the first was clearly theological. The reason for bringing in theology, and in a headline at that, related to the claim Prof. Hawking made in 1988 in his book *A Brief History of Time*, that a boundary-free physical theory makes the Creator unnecessary.[17] The claim spread far and wide because *A Brief History of Time* quickly became a runaway bestseller of perhaps all times. Within four years it sold in five million copies and is still selling. My concern here is not about that claim's illogicalities both from the viewpoint of physics and theology, which I dis-

[16] July 22, 2004, pp. A1 and A3. The report was written by D. Overbye.
[17] *A Brief History of Time* (Toronto: Bantam Books, 1988), pp. 173-74.

cussed elsewhere.[18] I am concerned here with the theological roots of a scientific resistance to the bearing of Gödel's theorem for physics, as an illustration of some broader aspects of scientific discoveries. And this resistance was clear in the article of *The New Scientist*. There one would look in vain for a reference to the fact that it was with an eye on Gödel's theorem that Prof. Hawking reversed his claim about a boundary-free physical theory. One has to go well beyond *The New Scientist* and even a *Brief History of Time* to see the depths of Prof. Hawking's resistance to Gödel's theorem. When that book of his was published in 1988, two years had gone by since the publication of *Kurt Gödel. Collected Works. Volume I. Publications 1929-1936*.[19] There in the Introduction one reads that Prof Hawking is one of the authors of introductions to various papers of Gödel. Volume I contains no such introduction by Prof. Hawking, who most likely was asked to write an introduction to Gödel's paper on rotational cosmology.[20] No second volume of that *Collected Works* has so far appeared. But since according to the same main Introduction to Volume I, that Volume had long been in preparation, one may safely assume that as early as 1980 Prof. Hawking's attention was explicitly called to Gödel's work.

At any rate it would be well nigh impossible to assume that already during his student years in Cambridge, that is, the 1960s, Hawking would have remained unaware of Gödel's paper of 1931 which contains the incompleteness theorem, and the less so as the theorem was widely discussed in England in the 1950s and 1960s in connection with debates on artificial intelligence.[21] Moreover, it was in Great Britain that the best English translation of Gödel's paper was published in 1962, with an introduction by the Cambridge philosopher of science, R.B. Braithwaite.[22]

[18] 'Evicting the Creator', (1988); reprinted also in my *The Only Chaos and Other Essays* (Lanham, Md.: University Press of America, 1990), pp. 152-161.

[19] Under the editorship of Solomon Feferman (New York: Oxford University Press; Oxford: Clarendon Press, 1986).

[20] It appeared in two instalments. The first, 'An example of a new type of cosmological solutions of Einstein's field equations of gravitation', *Reviews of Modern Physics* 21 (1949), pp. 447-50; the second, 'Rotating universes in general relativity theory', in *Proceedings of the International Congress of Mathematicians, Cambridge, Massachusetts, USA August 30-September 6, 1950* (Providence, R.I.: American Mathematical Society, 1952), vol. 1, pp. 175-181.

[21] See my *Brain, Mind and Computers* (1969), 3d enlarged edition (Washington: Regnery Gateway, 1989), pp. 214-16.

[22] Kurt Gödel, *On Formally Undecidable Propositions of Principia Mathematica and Related Systems*, trans. B. Meltzer, with an Introduction by R.B. Braithwaite (Edinburgh: Oliver & Boyd, 1962).

But there is one more fact, of which I learned only in June 2004. It was then that out of the blue I was contacted by Mr John Beaumont, formerly the legal counsel to Leeds University. Though not a physicist, Mr Beaumont has for years followed closely the developments in physics. He read *A Brief History of Time* shortly after its publication. Two years later he bought a copy of my book, *God and the Cosmologists*, or the text of my Fremantle Lectures, given in Oxford. In that book the entire chapter 4, with the title 'Gödel's Shadow',[23] deals with the bearing of Gödel's theorem on physics. My book alerted Mr Beaumont to the significance of Gödel's theorem for physics and he informed Prof. Hawking about it. To that communication Mr Beaumont received no reply.[24]

So much about my claim, if it had to be made at all, that Prof. Hawking had for almost two decades been aware of Gödel's theorem, before he took it up in June 2002, in reference to physics. Worse, when he did so, he made the impression that he was the first to do so. At any rate, he made the erroneous claim that Gödel's theorem means the end of physics. It means exactly the opposite. A physicist may hit upon a theory which at a given moment could cope with all known problems and phenomena in physics. But he cannot reasonably expect that in the future nothing will be observed that would require a radical overhaul of the theory. And because of Gödel's theorem, the physicist in question cannot claim that the apparent mathematical perfection of the theory forecloses that possibility. In other words, precisely because of Gödel's theorem there will be no end to physics.

The purpose of this paper is not to vindicate my priority about the discovery of the bearing of Gödel's theorem to physics. Actually, sometime in the early 1970s I saw a book on physics, published a few years earlier than my *Relevance,* whose author stated briefly that because of Gödel's theorem it was not possible to formulate a final physical theory. Unfortunately, before I had time to write down the title of that book, it disappeared from my eyes. It may indeed be that there were other such books as well, a possibility which some historians of physics may find worth investigating.

The purpose of this paper was to probe into some ideological reasons about a strange resistance on the part of leading physicists to the connection between Gödel's theorem and the possibility of formulating a necessarily true physical theory. Given the heavily agnostic temper of thinking

[23] See note 10 above.

[24] This I know from an email, sent to me by Mr Beaumont in early June 2004, and entirely at his own initiative.

among leading physicists, I am not surprised that what I said failed to prompt a proper reaction on their part. But it is even more significant that they have equally ignored Hawking's paper of 2002. In fact they ignored even the report of that paper which appeared in the April 5, 2003, issue of *The New Scientist*. Why is it, one may ask, that whereas Prof. Hawking's very recent rejection of his theory of black holes makes news all over the world and appears on the front page of leading newspapers, his paper 'Gödel and the End of Physics', prompts no response on the part of physicists who work very much on a final theory?

Surely, it is not possible to assume that Prof. Brian Greene of Columbia University has not yet heard of Gödel's theorem, or that he has not heard of Hawking's much belated awakening to that theorem. When *The New Scientist* reported about it, Prof. Greene, best known for his work on superstring theory, was just finishing his book, *The Fabric of the Cosmos*.[25] The book is full of hopeful expressions that the string theory would be the final word in physics and an explanation of everything not only in physics but of everything beyond. Prof. Greene's failure to refer there to Gödel's theorem is all the more telling because he discussed over two pages Gödel's rotational model of the universe.[26] I cannot help thinking that Prof. Greene simply refuses to consider Gödel's theorem. The refusal here, too, is distinctly ideological in its nature, which becomes clear to anyone who pays attention to Prof. Greene's repeated endorsement of some form of materialism throughout his book. Again, there is much more than meets the eye in Prof. Greene's earlier book, *The Elegant Universe*, which, to make the irony complete, has the subtitle: *Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory*.[27]

Once more elegance was purchased at the price of substance. A poor bargain, beneath which there must lie strong motivations. Prof. Greene seems ignoring Gödel's theorem for a reason that should be obvious. As in his *Elegant Universe*, in *The Fabric of the Cosmos*, too, Prof. Greene repeatedly makes it known that for him the universe is the ultimate entity. For anyone with such a belief Gödel's theorem should be a thing most distasteful to consider. I have a certain measure of sympathy for that distaste. It is a little known secret about the history of philosophy, that no philosopher of

[25] With the subtitle, *Space, Time and the Texture of Reality* (New York: Alfred A. Knopf, 2004).

[26] *Ibid*., pp. 259-60.

[27] New York: W.W. Norton, 1999, xv + 448 pp. A second edition followed in 2003.

any stature has ever changed his basic convictions. Conversions are rare in philosophy and even rarer in matters theological. While the number of converts may be large, the number of converts who had considerable theological views is rare indeed. This holds true also of those, scientists or not, who hold strongly anti-theological views. And in this age of science when anything wrapped in science readily sells, nothing is so tempting than to wrap one's wares in science. It should therefore be difficult for some scientists, who construct a scientific cover for their antitheological views, to recognize their mistaken tactic.

My dispute is not with non-theistic or atheistic ideologies. Ideology, in a broad sense, is inevitable as long as one thinks. Ideology is always present at least in the form which a century and half ago became referred to as one's antecedent and often tacit assumptions. It is very important to probe into those assumptions if one is to see clearly the full picture about one's philosophical theory. Had the recently deceased Jacques Derrida done this he would have made a useful contribution to philosophy. Instead he cavorted in what has become known as 'deconstructionism', where for all practical purposes confusion is proposed as the means of enlightenment.

Tacit assumptions rule the final outcome of any debate. Therefore it is best to be clear and honest about them. A few years ago I suggested in this Academy that at meetings such as this, all participants should wear a necktie appropriate to their tacit assumptions. I should have, of course, known that such a suggestion would never be taken up. Yet the very constitution of this Academy calls, if not for the wearing of specific neckties, at least for an occasional airing of basic assumptions. This is so because the constitution of this Pontifical Academy calls for discussions on the relevance of this or that scientific finding on this or that doctrine or dogma of the Catholic Church. In other words, it is proper to consider here the relation of science and faith within the framework of at least the Plenary Meetings of the Academy. I am somewhat reluctant to mention this, because during the past fourteen years I have been coming to these meetings some contrary views have been voiced by some academicians in this aula.

About the relation of science and religion much nonsense has been offered ever since the rise of science four hundred years ago. One such nonsense is that they are in harmony or even in a sacred wedlock, to recall a famous remark from Newton's time. They are neither in harmony, and much less find themselves in such a wedlock. They cannot be in harmony, because they are about two different sets of propositions. Kepler in his

Harmonices mundi could dream about the music of planetary orbits, but that book would not have helped composers. Conversely the magnificent tonalities in Haydn's Oratorio 'The Creation' contained no clues for science. It is of little significance to claim that the first law of motion was first formulated in a distinctly theological context at the Sorbonne around 1330. Although this was enormously important for the future of physics, it would be a great exaggeration to say simply that modern science was born in a Christian context.[28] Modern exact physical science, as we find it first in Newton's *Principia*, has been cultivated with no reference to Christian theology whatsoever, insofar as that science was strictly physics and not some broad thinking about physics and the physical world. Equally misleading in the cliché about science and religion is that they are in fundamental conflict, in a warfare indeed, to recall a shibboleth very popular in the second part of the nineteenth century.[29]

There is in my mind only one serious objection that science can make to a religion which is much more than a worshipping of great nature. I do not think that the objection is serious, but in this age of science everything wrapped in science calls for a special consideration. I do not think that a final theory, even if necessarily true, would render the Creator unnecessary. That final theory still would have to deal with the incredibly high degrees of specificities everywhere in the material universe. Specificities are all cases of finiteness, that is, of restriction. They all provoke Leibniz's question: 'Why such and not something else?'.[30] Infinite perfection does not have to be explained. It is finite things that call for explanations and indeed they alone prompt calls for explanations. Those appreciative of the profundity and weight of Leibniz's question will alone cherish Chesterton's remark that the sight of a telephone pole is enough to prove the existence of a Creator.

But we live not in a philosophical but in a scientific age. Therefore for the benefit of those who can take seriously only science and practically nothing else, it is useful to point out that the idea of a necessarily final

[28] For such a restriction, see my *The Origin of Science and the Science of its Origin* (Edinburgh: Scottish Academic Press, 1978) and my *Means to Message: A Treatise on Truth* (1999), and especially my *Questions on Science and Religion* (Port Huron, Mich.: Real View Books, 2004).

[29] See on this my introduction to the re-edition of K.A. Kneller's *Christianity and the Leaders of Modern Science* (1911) by Real View Books (1995), pp. xiii-xiv.

[30] On that question of Leibniz in his essay on the ultimate origination of things (1697), which remained in manuscript until 1840, see my *Cosmos and Creator*, pp. 90-92.

theory is beset with an enormous defect, the defect being its mathematical incompleteness in terms of Gödel's theorem. Were that defect not there, minds attentive only to science might argue that the Theory of Everything (TOE) deprives the universe of its contingency. In that case the kind of religion, which begins with belief in the existence of a Father Almighty, would lose its credibility, though only within that very narrow perspective coated with science.

For those who think only within that narrow perspective and in addition entertain antitheological antecedent assumptions, the specter of Gödel's theorem may not be pleasant to contemplate. They have various ways for protecting themselves from its specter. One is, for instance, to write books with the title, *The Mind of God*,[31] and earn handsome royalties. They react to a mere whiff of real theology as King Lear looked at an ominous prospect and cried out: 'Oh, that way madness lies; let me shun that'. There is, to paraphrase Shakespeare, a madness in a method which demands resistance to the obvious. Another dubious method is to follow the example of the ostrich, which, according to the fable, buries its head when faced with an approaching enemy. It seems to me that the long-standing resolve to ignore Gödel's theorem shows something of the tactic which all real specimens of the avian kingdom have wisely refused to adopt.

Gödel's theorem does not mean the end of physics. On the contrary it assures physicists that they can work forever for a final theory, though with one important proviso. Even if they were to hit upon that final theory, they would not know with certainty that it is final. This lack of finality in physics has in Gödel's theorem a stronger proof than the very likely expectation that, as time goes on, experiment and observations would turn up data that would demand the complete overhaul of well-established theories, just as this happened a hundred years ago. This seems to be the argument in Prof. Weinberg's book *Dreams of a Final Theory* in which he pokes fun on dreams about them, while he keeps silent on Gödel's theorem,[32] although it is the only solid argument against final theories.

On essentially theistic grounds I hold that it is possible for the human mind to work out a physical theory that would fit all aspects of the physi-

[31] I am referring to Paul Davies' *The Mind of God: The Scientific Basis for a Rational World* (New York: Simon and Schuster, 1992).

[32] On Weinberg's book, see my review of if, 'To Awaken from a Dream, Finally!' (1994); reprinted in my *The Limits of a Limitless Science and Other Essays* (Wilmington, DE: ISI Books, 2000), pp. 149-59.

cal universe. After all, to recall a phrase of the Book of Wisdom, the most often quoted phrase of the Bible during the Middle Ages, 'God arranged everything according to measure, and number and weight' (*Wis* 11:20). This means that as long as one views exact science as 'the quantitative study of the quantitative aspects of things in motion', God's arrangement of the material world should appear fully scientific. On finding that final theory man could be rightly proud. Pride unrestrained is not, however, a blessing. For remedy man may take recourse to Gödel's theorem. As Herbert Feigl, a noted philosopher of science but hardly a religious man, once remarked, 'confession (is said to be) good for the soul'.[33] Confession or not, when an error is made the best policy is to admit it promptly. Otherwise, it becomes ever more difficult to do what nowadays is spoken of as 'damage control'. Those who in various ways swallow the universe as if it were a pill, to recall a remark of Robert Louis Stevenson,[34] do much damage, in the long run at least, not only to their own intellectual reputation, but also to the cause of a healthy intellectual climate. Would that reflections on discoveries promote that cause instead of jeopardizing it.

[33] For details, see my Gifford Lectures (note 10 above), p. 414.

[34] Stevenson's phrase is from his 'Crabbed Age and Youth' (1878). Since Stevenson spoke of the solar system, one wonders what simile would he find today when cosmologists play facile games with universes.