

Einstein and God

He thought God as revealed in the harmony and rational beauty of the universe called for a non-conceptual intuitive response in the humility, wonder and awe associated with science and art.

IN A RECENT BOOK Max Jammer, Rector Emeritus of Bar Ilan University in Jerusalem, a former colleague of Albert Einstein at Princeton, claims that Einstein's understanding of physics and his understanding of religion were profoundly bound together, for it seemed to Einstein that nature exhibited traces of God quite like "a natural theology." Indeed it is with the help of natural science that the thoughts of God may be tapped and grasped.¹ On the subject of Einstein and God Friedrich Dürrenmatt once said, "Einstein used to speak of God so often that I almost looked upon him as a disguised theologian."² I do not believe these references to God can be dismissed simply as a *façon de parler*, for God had a deep, if rather elusive, significance for Einstein which was not unimportant for his life and scientific activity. It indicated a deep-seated way of life and thought: "God" was not a theological mode of thought but rather the expression of a "lived faith" (*eines gelebten Glaubens*).

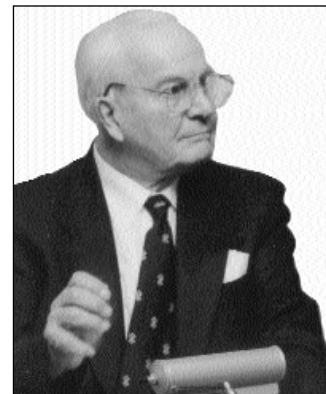
Albert Einstein was born in 1879 of secular Jewish parents who lived in Ulm and then in Munich, where he went to school. There in accordance with state law he had to be instructed in his faith; he was taught Judaism because of his ethnic heritage. By the age of twelve Einstein became deeply religious, combining ardent belief in God with a passion for the music of Mozart and Beethoven. He composed songs to the glory of God which he sang aloud to himself on his way to and from school.

Einstein regularly read the Bible, Old and New Testaments alike (which he continued to do throughout his life). He was taught the rudiments of Hebrew, but never mastered it, and he avoided the course for the traditional Bar-Mitzwa. He revelled in mathematics and music, especially in playing the violin, but recoiled from rigid orthodox rites such as those regarding kosher food,³ compulsory rules, and Talmudic ways of thought. He began to develop a distrust of all authority, including biblical and religious authority. He had an unusually independent attitude of mind, critical but not sceptical, which was accentuated by his resentment against the authoritarian discipline of his German schoolmasters. This led him to give up his uncritical religious fervour in order to liberate himself from what he spoke of as "the only personal", but without becoming atheistic or hostile to religion.

He never lost his admiration for the fundamental ends and aspirations of the "Jewish-Christian religious tradition", and had no doubt of the significance of what he called those "superpersonal objects and goals which neither require nor are capable of rational foundation".⁴ It was in this independent spirit, as "a typical loner", as he spoke of himself, without personal religious commitment, but with deep religious awe, that he cultivated and retained throughout his life unabated wonder at the immensity, unity, rational harmony, and mathematical beauty of the universe.

Later in life in a speech delivered in Berlin, he gave this illuminating account of himself:

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ordained minister, Dr. Torrance worked for ten years in the parish ministry, and served as moderator of the Church of Scotland's General Assembly. His numerous publications include: *Theological Science*; *Christian Theology and Scientific Culture*; *Preaching Christ Today: The Gospel and Scientific-Thinking*; *The Christian Doctrine of God: One Being Three Persons*; *Karl Barth, Biblical and Evangelical Theologian*; *The Mediation of Christ*; and *Space, Time and Incarnation*.

Although I am a typical loner in daily life, my consciousness of belonging to the invisible community of those who strive for truth, beauty, and justice has preserved me from feeling isolated. The most beautiful and deepest experience a man can have is the sense of the mysterious. It is the underlying principle of religion as well as all serious endeavour in art and science. He who never had this experience seems to me, if not dead, then at least blind. To sense that behind anything that can be experienced there is something that our mind cannot grasp and whose beauty and sublimity reaches us only indirectly and as a feeble reflection, this is religiousness. In this sense I am religious. To me it suffices to wonder at these secrets and to attempt humbly⁵ to grasp with my mind a mere image of the lofty structure of all that is there.

Before Albert was sixteen when he would have been obliged to undertake military training, he decided to move from school, leave Germany, give up German citizenship, and join his parents who had moved to Italy. Instead of continuing his education in Italy, however, Einstein chose to attend a school in Aarau in Switzerland where he enjoyed a rather freer mode of study and continued to cultivate his passion for Mozart and physics and think out things in his own way. As he was not an ethnic Swiss he was exempted from military training, which gave him time to indulge in extra-curricular pursuits, such as natural history expeditions with friends. He taught himself calculus and kept musing and thinking about light: “wondering especially what things might look like if someone went along for the ride with a light wave, keeping pace with it as it travelled through space”⁶.

When he was seventeen he finally announced his exit from the Jewish Religious Fellowship. After Aarau Einstein went to Zürich where he took courses in electrical engineering at its world famous Polytechnic. This led eventually to his first employment in a technical school at Wintertur, and then at the Swiss Patent Office in Bern, where he wrote his early epoch-making scientific papers published in *Annalen der Physik* for 1905.

Particularly interesting for our understanding of what Einstein held about God was his marriage to Mileva Maric, whom he had met in the physics classes, who belonged to a Greek Orthodox family in Serbia. While it was not personal belief or religious faith but physics which brought them together, there can be little doubt that it left some imprint on what he was

to think and say of God, evident in the use he frequently made of terms such as “transcendent” and “incarnate” to speak of “the cosmic intelligence” which lay behind the universe of space and time, which seems to indicate that there was rather more than just a way of speaking in what he said and thought of God. This is clearly reflected in an interview which Einstein later in life gave to an American magazine *The Saturday Evening Post*, in 1929:

“To what extent are you influenced by Christianity?”

“As a child I received instruction both in the Bible and in the Talmud. I am a Jew, but I am enthralled by the luminous figure of the Nazarene.”

“Have you read Emil Ludwig’s book on Jesus?”

“Emil Ludwig’s Jesus is shallow. Jesus is too colossal for the pen of phrase-mongers, however artful. No man can dispose of Christianity with a *bon mot*.”

“You accept the historical Jesus?”

“Unquestionably! No one can read the Gospels without feeling the actual presence of Jesus. His personality pulsates in every word. No myth is filled with such life.”⁷

In view of this interview it is understandable that Einstein is reported to have said that Christ Jesus was the greatest of all Jews.

Be that as it may, Einstein remained generally committed to the Jewish tradition and outlook, a commitment which became more and more resolute in face of Nazi attacks on himself and his Jewish scientific friends in Berlin, where he was appointed a Professor in 1913. The following year his wife Mileva with his two sons joined him in Berlin, but returned almost immediately to Switzerland — she hated Germany. Einstein wept when she left him — they were reluctantly divorced. He had once written to her, “You are and will remain a shrine for me to which no one has access.” Several years later he married a cousin, Elsa Löwenthal a widow in Berlin, who with her daughter Margot cherished him throughout the rest of his life. He continued to pursue his scientific research and teaching in Berlin, in spite of the Nazi campaign against the Universities, and the vilification of Einstein’s special and general theory of relativity, especially after his pub-

lication of *Die Grundlage der allgemeinen Relativitätstheorie* in *Annalen der Physik* in 1916.

Einstein's fearless championing of academic freedom finally drove him and Michael Polanyi, his Jewish colleague in Berlin, abroad. Einstein went to Princeton and Polanyi went to Manchester. Throughout his years in Berlin, Einstein had retained the admiration and support of Max von Laue and Max Planck, but objections to nominations for the award of the Nobel Prize to Einstein were lodged year after year, in fact six times, by several leading German physicists, notably by the virulently anti-Semitic Nobel Laureate Philip Lenard. The award was finally made in 1922, for his work, not on relativity, but on the photoelectric effect — Einstein sent the prize money to Mileva.

The bitter persecution of the Jews in Germany had the effect of drawing Einstein into closer relations also with Christian people, as his personal friendships with Max and Heidi Born who had become Quakers in Edinburgh, and with the Ross Stevensons and Blackwoods of Princeton Theological Seminary, make clear. When the Rev. Andrew Blackwood handed him a magazine clipping about the interview published in the *Saturday Evening Post*, and asked him if it was accurate, he read it carefully and answered, "That is what I believe".⁸

While the hounding and harrowing slaughter of Jews in Germany, and attacks on him by anti-semitic Americans, had the effect of making Einstein more and more resolute in open affirmation of his Jewishness, deepening the bond with his fellow Jews, they also had the effect of deepening his appreciation of the Christian Church and its opposition to Hitler and the holocaust. Here is a paragraph from a letter Einstein once sent to an American Episcopal Bishop about the behaviour of the Church during the holocaust.

Being a lover of freedom...I looked to the universities to defend it, knowing that they had always boasted of their devotion to the cause of truth; but, no, the universities immediately were silenced. Then I looked to the great editors of the newspapers whose flaming editorials in days gone by had proclaimed their love of freedom, but they, like the universities, were silenced in a few short weeks. Only the church stood squarely across the path of Hitler's campaign for suppressing the truth. I never had any special interest in the church

before, but now I feel a great affection and admiration because the church alone has had the courage and persistence to stand for intellectual truth and moral freedom. I am forced to confess that what I once despised I now praise unreservedly.⁹

Let me relate here what a friend of mine in Princeton told me about an illuminating event one day during the war, when Einstein learned of a prayer-meeting where Christians gathered to make intercession for Jews in Germany. To their surprise Einstein came along from his home at 112 Mercer Street with his violin and asked if he might join them. They welcomed him warmly, and he "prayed" with his violin. Yet in relation to petitionary prayer Einstein not infrequently reacted against "the fact that men appeal to the Divine Being in prayers and plead for the fulfilment of their wishes", for that implied for him, as we will note, a selfish "anthropomorphic" idea of God which he rejected.¹⁰

I associate that incident in Princeton when he joined a prayer meeting with his violin, with another event which took place in 1929 in Berlin, told to me by Max Jammer in a recent letter. It was the occasion when Yehudi Menuhin, the great Jewish violinist, gave a recital at a concert on Beethoven, Bach and Brahms, by the Berlin Philharmonic Orchestra conducted by Bruno Walter. Einstein was so overwhelmed that he rushed across the stage into Menuhin's dressing room, and exclaimed, "*Jetzt weiss ich, dass es einen Gott im Himmel gibt*"—"Now I know that there is a God in heaven."¹¹

What does all this tell us about Einstein the scientist and "God"? That is a matter which calls for a more considered thought than is usually given. And so, in the rest of this lecture I would like to address myself to two questions; 1) What did "God" mean for Einstein himself, and 2) What did "God" imply for his mathematical and physical science?

What Did "God" Mean for Einstein?

Early in his life Einstein came to refer to God as "cosmic intelligence" which he did not think of in a personal but in a "super-personal" way, for, as he learned from Spinoza, the term "personal" when applied to human beings cannot as such be applied to God.¹² Nevertheless he resorted to the Jewish-Christian way of speaking of God who reveals himself in an ineffa-

ble way as truth which is its own certainty. Spinoza held that “truth is its own standard”. “Truth is the criterion of itself and of the false, as light reveals itself and darkness,” so that “he who has a true idea, simultaneously knows that he has a true idea, and cannot doubt concerning the truth of the thing perceived.”¹³ Hence once a thing is understood it goes on manifesting itself in the power of its own truth without having to provide for further proof.¹⁴ Thus when God reveals himself to our minds, our understanding of him is carried forward by the intrinsic force of his truth as it continually impinges on our minds and presses for fuller realization within them.

In this way Einstein thought of God as revealing himself in the wonderful harmony and rational beauty of the universe, which calls for a mode of non-conceptual intuitive response in humility, wonder and awe which he associated with science and art. It was particularly in relation to science itself, however, that Einstein felt and cultivated that sense of wonder and awe. Once when Ernest Gordon, Dean of Princeton University Chapel, was asked by a fellow Scot, the photographer Alan Richards, how he could explain Einstein’s combination of great intellect with apparent simplicity, he said, “I think it was his sense of reverence.”¹⁵ That was very true: Einstein’s religious and scientific instinct were one and the same, for behind both it was his reverent intuition for God, his unabated awe at the thoughts of “the Old One”, that was predominant.

Although Einstein was not himself a committed Jewish believer he would certainly have agreed with the call of Rabbi Shmuel Boteach today to restore God himself, rather than *halacha*, as the epicentre of Judaism.¹⁶

Science can only be created by those who are thoroughly imbued with the aspiration toward truth and understanding. This source of feeling, however, springs from the sphere of religion. To this there also belongs the faith in the possibility that the regulations valid for the world of existence are rational, that is, comprehensible to reason. I cannot conceive of a genuine scientist without that profound faith. The situation may be expressed by an image: science without religion is lame, religion without science is blind.”¹⁷

That statement comes from his 1939 address to Princeton Theological Seminary, but far from being unique, it is reflected in statement after statement he made about science, religion, and God.

Count Kessler once said to him, “Professor! I hear that you are deeply religious.” Calmly and with great dignity, Einstein replied, “Yes, you can call it that. Try and penetrate with our limited means the secrets of nature and you will find that, behind all the discernible concatenations, there remains something subtle, intangible and inexplicable. Veneration for this force beyond anything that we can comprehend is my religion. To that extent I am, in point of fact, religious.”¹⁸

Einstein was certainly no positivist. Here are some other statements Einstein made about this.

By way of the understanding he [the scientist] achieves a far-reaching emancipation from the shackles of personal hopes and desires, and thereby attains that humble attitude of mind towards the grandeur of reason incarnate in existence, and which, in its profoundest depths, is inaccessible to man. This attitude, however, appears to me to be religious, in the highest sense of the word. And so it seems to me that science not only purifies the religious impulse of the dross of its anthropomorphism but also contributes to a religious spiritualization of our understanding of life.¹⁹

My religion consists of a humble admiration of the illimitable superior Spirit who reveals himself in the slight details we are able to perceive with our frail and feeble minds. The deeply emotional conviction of the presence of a superior reasoning Power, which is revealed in the incomprehensible universe, forms my idea of God.²⁰

Yet again:

You will hardly find one among the profounder sort of scientific minds without a peculiar religious feeling of his own . . . His religious feeling takes the form of a rapturous amazement at the harmony of natural law, which reveals an intelligence of such superiority that, compared with it, all the systematic thinking and acting of human beings is an utterly insignificant reflection.²¹

Still again, in another version of this statement, Einstein said:

Certain it is that a conviction, akin to religious feeling, of the rationality and intelligibility of the world lies behind all scientific work of a higher order. The firm belief, which is bound up with deep feeling, in a superior mind

revealing himself in the world of experience, represents my conception of God, which may, therefore be described in common parlance as 'pantheistic' (Spinoza).²²

What did Einstein mean, then, when he referred to God as “cosmic intelligence”, “the grandeur of reason incarnate in existence”, to which he not infrequently referred in a Talmudic expression as “the Old One”? He was not always consistent so that it is not easy to grasp precisely what he meant. But it seems clear that he conceived of God as the ultimate spiritual ground of all rational order which transcends what the scientist works with as natural laws—a point to which we shall return later—but unlike the Jewish-Christian religion he did not think of that in what he called a “personal” or “anthropomorphic” way, that is, as a God conceived in man’s image, but in a “superpersonal” (*ausserpersönlichen*) way freed from the fetters of the “only personal” (*Nur-Persönlichen*), or people’s selfish desires.

What is important”, he said, “is the force of this superpersonal content and depth of the conviction concerning its overpowering meaningfulness, regardless of whether an attempt is made to unite this content with the divine Being for otherwise it would not be possible to count Buddha and Spinoza as religious personalities. Accordingly, a religious person is devout in the sense that he has no doubt of the significance and loftiness of these superpersonal objects and goals which neither require nor are capable of rational foundation.”²³

Einstein was often asked, “Do you believe in God?”, to which he sometimes replied “I believe in Spinoza’s God, who reveals himself in the harmony of all being”.²⁵ By “God”, Spinoza wrote at the very beginning of his *Ethica*, “I mean a being absolutely infinite—that is, a substance consisting in infinite attributes, of which each expresses eternal and infinite essentiality”. Proposition XV of *Ethica* stated: “Whatever is, is in God, and without God nothing can be, or be conceived.”²⁵

Einstein certainly held, as his constant appeal to God showed, that without God nothing can be known, but what did he really mean by his appeal to Spinoza? Once in answer to the question “Do you believe in the God of Spinoza?” Einstein replied as follows:

I can’t answer with a simple yes or no. I’m not an atheist and I don’t think I can call myself a pantheist. We are in the position of a little child entering a huge library filled with books in many different languages. The child knows someone must have written those books. It does not know how. The child dimly suspects a mysterious order in the arrangement of the books but doesn’t know what it is. That, it seems to me, is the attitude of even the most intelligent human being toward God. We see a universe marvellously arranged and obeying certain laws, but only dimly understand these laws. Our limited minds cannot grasp the mysterious force that moves the constellations. I am fascinated by Spinoza’s pantheism, but admire even more his contributions to modern thought because he is the first philosopher to deal with the soul and the body as one, not two separate things.²⁶

In a letter to Henry Oldenburg, the secretary of the Royal Society, Spinoza declared, “I do not think it necessary for salvation to know Christ according to the flesh: but with the Eternal Son of God, that is the Eternal Wisdom of God, which had manifested itself in all things, and especially in the human mind, and above all in Christ Jesus, the case is far otherwise.”²⁷ He himself, he claimed, “paid homage to the Books of the Bible, rather than to the Word of God.”²⁸ Spinoza read the New Testament Scriptures as well as the Old Testament Scriptures, e.g. St John’s Gospel and the Epistle to the Hebrews, in a Hebraic way. He complained to Henry Oldenburg: “You think that the texts in John’s Gospel and in Hebrews are inconsistent with what I advance, because you measure oriental phrases by the standards of European speech; though John wrote his Gospel in Greek, he wrote it as a Hebrew.”²⁹ That is what John Reuchlin used to call *veritas Hebraica*.²⁹ When another Jew, Martin Buber, whom Einstein had known for forty years, one day in Princeton pressed him hard to reveal his religious belief, Einstein said, “What we [physicists] strive for...is just to draw his lines after him.” The deeper one penetrates into nature’s secrets, he declared, the greater becomes one’s respect for God.

Einstein held that the main source of the present-day conflicts between the spheres of religion and of science lay in “the concept of a personal God” for that was to think of God in an anthropomorphic way, and to project into him figurative images and human psychological

notions of personality, which give rise, he held, to religious practices of worship and notions of providence shaped in accordance with human selfish desires. That did not mean that Einstein thought of God merely in some impersonal way, for, as we have noted, he thought of relation to God in a sublime *superpersonal* way which he confessed unable to grasp or express and before which he stood in unbounded awe and wonder. Hence he felt it deeply when Cardinal O’Connell of Boston charged him with being an atheist.³¹ When a newspaperman once accosted him in California with the question, “Doctor is there a God?”, Einstein turned away with tears in his eyes.³²

What, then, did Einstein mean by claiming to believe in Spinoza’s *Amor Dei Intellectualis*, the intellectual love of God, the highest happiness that man can know? He was approving of Spinoza’s idea that to be rational is to love God and to love God is to be rational, so that for one to engage in science is to think the thoughts of God after him. With Spinoza, however, that involved the outright identification of God with nature, a causally concatenated whole, whereas, as we have seen, with Einstein the *Verständlichkeit* of God was so exalted that it could not be reduced to the logico-causal intelligibilities of nature. A transcendent relation had to be taken into account.

As a Jew himself Einstein naturally resonated with Spinoza, the greatest of all modern Jewish philosophers, for they shared in the traditional unitary concept of man as body of his soul and soul of his body. Although there was much in Spinoza’s philosophy which Einstein could not accept, what did appeal to him was Spinoza’s rejection of Cartesian and other forms of dualism, and his unitary conception of the universe with its inherent rational harmony. That was both a help and a problem for Einstein. It fuelled his great drive toward unified field-theory, and his rejection of a dualism between time and space, wave and particle, relativity theory and quantum theory, but Spinoza’s logico-mathematical and hard causalist uniformity gave rise to an absolute rigid determinism which conflicted with Einstein’s realist and dynamic understanding of the openness of the universe, in his rejection of the closed Euclidean system of the world.

Here let me refer to a very interesting letter, recorded by Helen Dukas, which Einstein wrote to a child who asked him whether scientists prayed.

I have tried to respond to your question as simply as I could. Here is my answer. Scientific research is based on the idea that everything that takes place is determined by laws of nature, and therefore this holds for the actions of people. For this reason, a research scientist will hardly be inclined to believe that events could be influenced by prayer, i.e. by a wish addressed to a supernatural Being. However, it must be admitted that our actual knowledge of these laws is only imperfect and fragmentary, so that, actually the belief in the existence of basic all-embracing laws in nature also rests on a sort of faith. All the same this faith has been largely justified so far by the success of scientific research. But, on the other hand, everyone who is seriously involved in the pursuit of science becomes convinced that a spirit is manifest in the laws of the Universe—a spirit vastly superior to that of man, and one in the face of which we with our modest powers must feel humble. In this way the pursuit of science leads to a religious feeling of a special sort, which is indeed quite different from the religiosity of someone more naive.”³³

This brings me to my second question.

What Did “God” Imply for Einstein’s Mathematical and Physical Science?

Early in his career Einstein’s studies of Newton and Kepler convinced him that there is no logical path to knowledge of the laws of nature, for there is no logical bridge between phenomena and their theoretical principles.³⁴ This was greatly reinforced by his study of James Clerk Maxwell.³⁵ It is the extra-logical problem, he held, that is essential, namely, the ontological reference of thought to reality.³⁶ Within the preestablished harmony of the universe, “ideas come from God”—they are revealed to the mind tuned into the master plan of the universe, and are apprehended through intuition resting on sympathetic understanding of experience. “He [the scientist] has to persist in his helpless attitude towards the separate results of empirical research, until principles which he can make the basis of deductive reasoning have revealed themselves to him.”³⁷ “The supreme task of the physicist is to arrive at those elementary universal laws from which the cosmos can be built up by deduction. There is no logical path to these laws; only intuition resting on sympathetic understanding of

experience, can reach them...There is no logical bridge between phenomena and their theoretical principles; that is what Leibnitz described so happily as a 'preestablished harmony.'"³⁸

Einstein used to speak of this non-logical, intuitive way of reaching knowledge, as "tapping into God's thoughts".³⁹ "The deeper one penetrated into nature's secrets, the greater becomes one's respect for God."⁴⁰ Once when drawing out the implications of relativity theory in an amusing way which he hoped was in tune with the thoughts of God, he said "I cannot possibly know whether the good Lord does not laugh at it and has led me up the garden path!"⁴¹ I think of that in connection with the fact that the equations of relativity theory predict their own limits, and thus direct us back to a zero point in the expansion of the universe from what is commonly known as "the black hole", which, as Henry Margenau held, implied the principle of *creatio ex nihilo*.⁴² Einstein pointed out that "one must not conclude that the beginning of the expansion of the universe] must mean a singularity in the mathematical sense." Then he added: "This consideration does, however, not alter the fact that the 'beginning of the world' really constitutes a beginning."⁴³ Such a beginning, a *creatio ex nihilo*, was of course an idea which was ruled out by Spinoza's *Deus sive Natura* notion of God as an infinite, eternal self-creating substance, and of his conception of the universe as non-contingent and completely necessary in its identification with God.

Now in order to indicate something of what "God" meant for Einstein's science, let us consider the bearing of three of his often repeated epigrammatic 'sayings' about God: "God does not play dice"; "God does not wear his heart on his sleeve"; and "the Lord is subtle but not malicious."

"God does not play dice".

This seems to have been suggested by one of the propositions of Spinoza's *Ethics*, "In the nature of things nothing accidental is granted, but all things are determined by the necessity of the divine nature for existing and working in a certain way. In short, *there is nothing accidental in nature*."⁴⁴ "God does not play dice" was asserted again and again by Einstein in connection with his belief in a fully rational world of law and order, and in rejection of the appeal to random elements in certain forms

of quantum theory, e.g. the so-called "uncertainty principle" put forward by Heisenberg. Far from having explanatory value, what is called chance is after all a negative way of thinking, or rather a way of not thinking. Einstein's "God" would not allow him to rest content with anything less than a rigorous scientific description of the intrinsic orderliness of nature at its micro-physical as well as at every other level of reality. Einstein once wrote of his objections to the then current form of quantum theory that his view of the matter "does not represent a blind-man's buff with the idea of reality".⁴⁵

"God does not play dice" imports a belief in an objective intelligibility in the continuous dynamic structures and transformations in the space-time reality of the universe which we may apprehend, but only at relatively elementary levels through open structures, even though they are mathematically precise in their formalisation. As I understand him, even Heisenberg toward the end of his life concluded that in quantum theory the scientist is in touch with nature which in its depth is so subtle and elusive that it cannot be explained in terms of the couplet "chance and necessity". That "God does not play dice" highlights the fact that *chance* is after all a negative way of thinking, or rather a way not to think. This is a lesson I believe that many scientists today, especially perhaps in biology, need to learn—their appeal to "chance" too often appears to be a sort of "scientist's God of the gaps"!

Behind all Einstein's thought lay the role given in the Jewish-Christian religion to the primacy and constancy of light. Recall the Genesis account of creation—the primacy of light: "And God said, Let there be light: and there was light." God is himself eternal *uncreated Light*, but he created the universe in such a way that it is governed by *created light*. We cannot see light, but see only what is lit up by light. We shall return to this later. It is through deciphering light signals that all our knowledge of the cosmos in macroscopic and microscopic levels is learned. We owe that to James Clerk Maxwell who discovered the mathematical properties of light, and the central role they have in scientific theory. Clerk Maxwell was followed by Einstein in giving light a primary place in his scientific description of the space/time universe.

As Hermann Weyl, Einstein's colleague in Princeton, expressed Einstein's understanding of light: all bodies in motion are defined rela-

tionally in terms of space and time, and space and time are defined relationally with reference to light, but light is NOT defined with reference to anything else. Light has a unique physical and metaphysical status in the universe—it is an ultimate factor, the Constant expressed as C in scientific equations. (thus Einstein's famous formula, $E = MC^2$). If light were not constant, if the movement of light varied or wobbled in any way, there would be no order, only random disorderly events, chaos. It is light that reveals the orderly nature of things. That is why Einstein recoiled from giving random or chance-events a role in scientific explanation or the formulation of scientific theory. The constancy of light throughout the created order reflects the faithfulness of God of which the Hebrew and Christian Scriptures all speak—God does not play dice. Yes, it was Einstein's belief in God, in God as the ultimate ground of all order, rational and moral order, that governed his scientific thinking and daily life. Spinoza, no less than Einstein, believed in the faithfulness of God—but the oneness he posited between God and nature meant for Spinoza that the kind of order he envisaged was of a determinist kind to be understood in terms of rigid logico-causal connections.

Now there are clearly deep problems here in Einstein's appeal to the God of Spinoza. Like Spinoza he was right to reject a strict bifurcation of nature into mind and body, subject and object, but what of Spinoza's rigidly logical and causalist conception of God and the universe? In insisting that "God does not play dice", Einstein was accused, for example by Max Born, of being a hardline determinist, but as Wolfgang Pauli showed, writing to Born in Edinburgh from Princeton,⁴⁷ Einstein was not a determinist but a *realist*, with the conviction that, in line with Clerk Maxwellian field theory and general relativity theory, nature is governed by profound levels of intelligible connection that cannot be expressed in the crude terms of classical causality and traditional mathematics. He was convinced that the deeper forms of intelligibility being brought to light in relativity and quantum theory cannot be understood in terms of the classical notions of causality—they required what he called *Übercausalität*—supercausality. And this called for "an entirely new kind of mathematical thinking", not least in unified field theory—that was a kind of mathematics he did not even know, but which someone must find.

"God does not wear his heart on his sleeve".

In their Jewish tradition both Einstein and Spinoza adhered strictly to the second Commandment that forbade thinking of God in any image or visible form. With Spinoza this was evidently reflected in his rejection of sense-perception as a mode of genuine objective knowledge. That is also the fundamental idea expressed in the statement "God does not wear his heart on his sleeve" which Einstein applied to physical science. It formulates the profound conviction that the real secrets of nature, its hidden intelligible order cannot be read off appearances, or be logically derived from the observational patterns of its phenomenal surface, but only by "tapping into the thoughts of God" as he "reveals" them to us. We cannot see God, but we may see him in the light of his own light. As the Hebrew Psalmist declared, "In thy light we see light."

Let us recall here the point noted earlier about the central role of light in the created universe. There we were concerned with the constancy of light, but here our concern is with the invisibility of light. It is through deciphering the mathematical patterns carried by light signals that all our knowledge of the space/time universe in its vast or tiny dimensions is derived. This understanding of light initiated an immense revolution in scientific inquiry, for it meant that the invisible is not to be explained in terms of the visible, but the visible in terms of the invisible. We do not see light itself, but see only what is lit up by light—"grasping reality in its depth", "tapping into the thoughts of the Old One", as Einstein used to say. "God does not wear his heart on his sleeve."

This is not to say that Einstein was concerned to look for hidden causes detached from, or of a different category from, the ordered regularity we experience in our everyday world, for he was just as concerned to reject the 'occult' as Bacon and Newton, and was even more concerned than they were, because he would have nothing to do with the kind of dualism upon which the occult seemed to thrive. Einstein's concern was rather to penetrate into the deep invisible dynamic ontological structure of the ordered regularity of things to which the phenomenal patterns of that regularity are coordinated, and by which they are controlled. That is particularly evident in the epistemological revolution brought about by general relativity theory which showed that empirical and theoretical factors, being and form, belong together at all levels of nature and our knowledge of it.

Hence scientific inquiry must penetrate into the inner imageless constitutive structure of things, which is invariant through all relativity for the human knower, and which can be grasped not through observational or phenomenological investigation but only by intellectual penetration or intuitive insight. While the outward shape on the surface of existence remains observable and imageable, and is variant for every observer, the invisible imageless ontological structure remains constant and invariant for all observers. As such it provides the objective frame underlying the observable variations correlated with it, and therein constitutes the integrative force of their order on the phenomenal level, even of their surface connection with appearances.

To grasp nature like that intuitively and unitively in its objective depth and inherent relatedness, and in such a way as to do full justice to the differences and relativities of our observational experience without allowing them to disintegrate into pluralistic relativism, is what rigorous science is about. But it does mean that we have to think in a dimension of ontological depth in which the surface of things is coordinated with a deep invisible, intelligible structure, and thus think empirical and theoretical factors, phenomenal and noumenal levels of reality together, if we are really to reach knowledge of things in accordance with their distinctive nature and constitutive ground. “God does not wear his heart on his sleeve”.

There is, however, a deep difference here between Einstein’s thought and that of Spinoza. Spinoza’s philosophy was in its way a Jewish form of the old Latin Stoic idea of *deus sive natura*, for according to him there is only one all-inclusive self-caused substance “God or nature” which he identified with the universe conceived as an infinite necessary whole and which is to be understood only in a logical-causal way—for him “God” was in no sense transcendent to the universe. In contrast Einstein’s formulation of the principle that “God does not wear his heart on his sleeve”, imports a profounder sense of the astonishing intelligibility (*Verständlichkeit*) of the universe and its incomprehensible transcendent ground in God. “The scientist”, he said, “is activated by a wonder and awe before the mysterious comprehensibility of the universe which is yet finally beyond his grasp”.⁴⁸ “In its profoundest depths it is inaccessible to man”.⁴⁹ That is why, for Einstein, science without religion is lame.

“Subtle is the Lord, but malicious he is not.”

This saying, now engraved above a fireplace of the faculty lounge of the Mathematics Department in Princeton, is the translation of *Raffiniert ist der Herr Gott, aber boshaft ist Er Nicht*.⁵⁰ By that Einstein said he meant “Nature hides her secret because of her essential loftiness, but not by means of ruse.”⁵¹ It was, like the other sayings, often repeated, not always in the same words. I prefer the stronger form: *Raffiniert ist der Herr Gott, aber hinterlistig ist Er nicht*, which suggests that while God is subtle he is not wily or artful, he is deep but not devious—he does not deceive us or play tricks with us.

If “God does not wear his heart on his sleeve” is meant to express the idea that the secrets of nature cannot be read off its phenomenal surface, “God is deep but not devious” expresses the complexity and subtlety yet ultimate simplicity and reliability of the universe. That is to say, the immanent order hidden behind the intricate and often baffling complex of connections which we find in the universe is essentially trustworthy, for in spite of all that might appear to the contrary when we come up against sets of events for which there seems to be no rational explanation, the universe is not arbitrary or evil, but unitary and trustworthy in its intelligibility.

This conviction relates to the point, to which I have referred earlier, that light has a unique physical and metaphysical status in the universe. If all bodies in motion are defined with reference to space and time, all space and time are defined with reference to light. Undefined by reference beyond itself, light is the great Constant, with reference to which all else we know in nature is relationally ordered, known and defined, and upon which we invariably rely. That holds good in spite of the fact that in our atomic and sub-atomic investigations, in terrestrial and astrophysical explorations of the universe as far as we can reach through space and time, we meet problems which may appear intractable to the laws of physics, as hitherto formalised. Throughout all the dynamic multivariable structures that pervade the universe of bodies in motion, somehow the constancy of light with its unique metaphysical status supports the conviction that “God does not play tricks with us”. That is to say, there is an immanent order in the universe of the inviolability of which we remain totally convinced, for apart from it the universe would nowhere be accessible to rational inquiry and we ourselves who are creatures of space and time

belonging to the universe could not be capable of rational thought or behaviour of any kind. Thus while in the logical sense belief in order in the universe is neither verifiable nor falsifiable, it remains the most persistent of all scientific convictions, for without it there could be no science at all; hence we do not believe that there is or could be anything that can ultimately count against it. God is faithful, and does not let us down; he is always trustworthy.

That was a conviction to which Einstein remained very firmly committed in place of the claims of the quantum theorists who called in question the deep invariable order in the sub-atomic realm, where nature appeared to be causally discontinuous, and irrational. Einstein had himself to face a similar problem over the implications of general relativity for our understanding of a non-Euclidean universe of curved space, when he insisted that “as far as mathematical propositions refer to reality, they are not certain; and as far as they are certain they do not refer to reality.”⁵² Traditional logic applies to flat and not to curved space, so that new ways of thought are called for, which do not conform to the classical laws of logic and physics. That is why instead of going along entirely with the Copenhagen-Göttingen form of quantum theory, Einstein pointed to the need for “an entirely new kind of mathematics” to cope with the profound intelligible relations with which quantum scientists sought to grapple.⁵⁴ A profound revolution in the logical structure of science was needed, in line with and in development of the logical structure of science initiated by Clerk Maxwell, when he called for “a new mathesis” in mathematics, and pointed to the need for a dynamic kind of mathematics with time relations built into it.

All this is to say, that in mathematical and scientific explanation a deeper more subtle way of thinking is needed, in which new factors of profound rationality have to be taken into account. God is subtle but not malicious or devious, and he does not lead us up the garden path, or ask us to play blind man’s buff!

The way that Einstein so often connected the notion of *Order* with God reflects the fact that order is one of the ultimate beliefs which, while rational, cannot be proved—for we have to assume order either in trying to prove or disprove it—all rational order points beyond itself to an ultimate ground of order. That is why Einstein could not be an atheist, if only

because apart from God the transcendent ground of all order, there could be no rational thought, let alone any science.

Now in concluding this lecture let me recall a point of great importance which few scientists today have taken up or perhaps dared to take into account. It is here that we can discern Einstein’s sharpest deviation from the God of Spinoza. It was his adherence to Spinoza’s rejection of dualism, and his insistence on the rational unity and lawful harmony of the universe, which made Einstein give so much attention for many years to the development of a unified field theory, one in which, for example, relativity theory and quantum theory could be united in a universal rational structure.

Already in 1929 Einstein had raised a matter of great importance in this connection.⁵⁴ He pointed out that science has now reached the stage where it cannot be satisfied simply with describing *how* nature is what it is in its ongoing processes, but must press on to ask “*why* nature is what it is and not something else”.⁵⁵ That is to say, science must not be satisfied with determining the laws of how nature as a matter of fact behaves, for if it wants to understand their “logical unity”, to which he himself was committed in unified field theory, then science must penetrate into the transcendent ground of those laws and find the ultimate justification for them. Einstein went on to say that this might appear to be a rather “Promethean” undertaking, but here we have to do with what he called “the religious basis of scientific enterprise.”⁵⁶

To introduce the question *Why?* back into the inner structure of natural and physical science was to reject the rationalistic dualism of the Enlightenment between the *how* and the *why* to which are to be traced the damaging splits in western culture, but it was also to point to God as the ultimate ground of all rational order and the transcendent reason for all the laws of nature. What a startling light that throws upon what Einstein himself really meant by “God”! It is only from God that we can understand the *why* or the fundamental *purpose* of the created universe.

In view of this conviction, let me note two things. (1) Einstein never gave any attention to the problem of evil—evil is ultimately irrational and inexplicable, an abysmal mystery, as St Paul called it. There is *no reason why* to evil. (2) As far as I know, Einstein showed no interest in redemption—either in the biblical significance of atonement, or in the Jewish celebration

of *Yom Kippur*. Yet it is only from God who does not play dice, who does not wear his heart on his sleeve, and who is deep but not devious, that we may be given an understanding of the ultimate reason for the created universe, and of his redemptive purpose for a world that has gone astray. It may be interesting to note that another Jewish scientist, Ilya Prigogine, who is not a believer, yet not a determinist like Spinoza who had no place in his thought for “time”, has actually spoken of time as “redeemable”.⁵⁷

Notes for Einstein and God

1. Max Jammer, *Einstein und Die Religion*, Konstanz, 1995.
2. Friedrich Dürrenmatt, *Albert Einstein*, Zürich, 1979, p.12, cited by Max Jammer, op. cit. p. 54: “Einstein pflegte so oft von Gott zu sprechen, dass ich beinahe vermute, er sei ein verkappter Theologe gewesen.”
3. While in his religious years he tried to dissuade his parents from eating pork, it is related of a later occasion that when he and some friends were entering a restaurant, an Orthodox Jew asked whether the food was strictly kosher—Einstein replied, “Only an ox eats strictly kosher”! Denis Brian, *Einstein, a Life*, New York, 1996, p.128. But Einstein was never disrespectful of the beliefs and habits of his orthodox friends.
4. Cf. Abraham Pais, ‘*Subtle is the Lord...*’, Oxford, 1982, p. 319. Cf. also Einstein, *Ideas and Opinions*, New York, 1954; “The highest principles for our aspirations and judgments are given to us in the Jewish-Christian religious tradition.” See also Max Jammer, op. cit. p. 48f.
5. Cited by Denis Brian, *Einstein, a Life*, New York, 1996, p. 234.
6. See Denis Brian, *Einstein, a Life*, New York, 1996, p. 12.
7. George Sylvester Viereck, “What Life Means to Einstein”, *The Saturday Evening Post*, 26 October 1929.
8. Denis Brian, *Einstein, a Life*, New York, 1996, p. 277f.
9. Reported in *The Evening News*, Baltimore, April 13, 1979.
10. See his 1939 address to Princeton Theological Seminary, *Ideas and Opinions*, New York, 1954, p.46.
11. This is also recounted by Denis Brian, op. cit., p. 193.
12. Cf. Stuart Hampshire, Spinoza, revised edition, Harmondsworth, 1962, p. 49: “It is a general principle in Spinoza’s philosophy, which he constantly repeats to prevent misunderstandings, that no term when applied to God can possibly bear the meaning which it has when applied to human beings.”
13. Spinoza, *The Chief Works of Benedict De Spinoza*, Vol. II, *Ethica*, Proposition XLIII, translated and edited by R.H.M. Elwes, London, 1889, p. 114; *De Intellectus Emendatione*, pp. 12-19. Cf. Stuart Hampshire, Spinoza, p. 99f.
14. *Tractatus de intellectus emendatione*, edit. by R. H. M. Elwes, p. 19.
15. Alan Windsor Richards, *Einstein as I Knew Him*, Princeton, 1979.
16. Rabbi Shmuel Boteach, *The Jewish Chronicle*, 26.10.96.
17. *Ideas and Opinions*, New York, 1954, p. 46.
18. Cited by Denis Brian, op. cit. p. 161.
19. *Out of My Later Years*, New York, 1950, p. 32; and *Ideas And Opinions*, New York, 1954, p. 49.
20. Cited by Lincoln Barnett, *The Universe and Einstein*, New York, 1948, Mentor soft cover edition, 1963, p. 109.
21. *Ideas and Opinions*, New York, 1954, p. 40.
22. Einstein, *The World as I See It*, London, 1955, p. 131.
23. *Ideas and Opinions*, p. 44f. In his reference to Buddha Einstein may have had Ben Gurion in mind or even David Bohm! Cf. the discussion, reported by Max Jammer, which Einstein once had with Rabindranath Tagore about his book “The Religion of Man”, when Einstein said: “I am more religious than you are!” Op. cit. p. 43.
24. See Denis Brian, op. cit. p. 127.
25. See the translation by R.H.M. Elwes, London, 1889, pp. 45 and 51.
26. Denis Brian, op. cit. p. 186.
27. *Spinoza’s Correspondence*, letter LXXXIII—see *Spinoza’s Works*, Vol. II, edited by R. H. M. Elwes, 1899, p. 299.
28. *A Theologico-Political Treatise*, *Spinoza’s Works*, vol. I, p.9.

29. Letter XXIII (LXXV), *The Chief Works of Spinoza*, Vol. II, London, 1889, p. 303.
30. John Reuchlin, *De verbo mirifico*, 1552, 2.7, p. 129. Cf. my essay “The Hermeneutics of John Reuchlin, 1455-1522”, *Church, Word and Spirit, Historical and Theological Essays in Honor of Geoffrey W. Bromiley*, Edited by J.E. Bradley and R.A. Muller, Grand Rapids, 1987, pp. 107-121.
31. Cf. Max Jammer, *op. cit.* p.54; and Helen Dukas, *Albert Einstein—The Human Side*, Princeton, 1979, p. 132.
32. Denis Brian, *op. cit.* p. 206.
33. *Albert Einstein: The Human Side*, edited by Helen Dukas and Banesh Hoffmann, Princeton University Press, 1989, p. 32f. My attention has been drawn to this passage by Mark Koonz, formerly of Princeton Theological Seminary.
34. *Einstein, The World as I See It*, London, 1935, p. 125f.
35. See *The Evolution of Physics, from Early Concepts to Relativity and Quanta*, by Albert Einstein and Leopold Infeld, New York, 1938, pp. 125ff; and “Maxwell’s Influence on the Development of the Conception of Physical Reality”, by Einstein, reproduced in my edition of James Clerk Maxwell, *A Dynamical Theory of the Electromagnetic Field*, Edinburgh, 1982, pp. 29-32.
36. *Ibid.* p. 174.
37. *Ibid.* p. 128; and see the Essay on “Physics and Reality”, *Out of My Later Years*, New York, 1950, pp. 60ff.
38. *The World as I See It*, p. 125f.
39. Cf. Denis Brian, *op. cit.* pp. 61 and 173.
40. Cited by Denis Brian, *op. cit.* p. 129.
41. Cf. again Denis Brian, *op. cit.* p. 67.
42. Henry Margenau, *Thomas and the Physics of 1958, Milwaukee*, 1958, pp. 41-43. See Max Jammer, *op. cit.*, pp. 102f. and 115.
43. A. Einstein, *The Meaning of Relativity*, Princeton, 1953, p. 129.
44. Baruch Spinoza, *Ethica*, proposition XXIX: *In rerum natura nullum datur contingens, sed omnia ex necessitate divinae naturae determinata sunt ad certo modo existendum et operandum*. English translation by Andrew Boyle, Everyman’s Library, vol. 481, London, 1959, p. 23. See also Max Jammer, *op. cit.* p. 38f.
45. Irene Born, *The Born-Einstein Correspondence*, London, 1971, p. 180f.
46. Irene Born, *The Born-Einstein Correspondance*, London, 1971, pp. 217-218 and 322-224.
47. See the report of Denis Brian, *Einstein, A Life*, New York, 1996, p. 370.
48. Einstein, *Out of My Later Years*, pp. 30,60.
49. *Ideas and Opinions*, p. 49; cf. also p. 40.
50. Thus Denis Brian, *op. cit.* p. 127.
51. See Abraham Pais, ‘*Subtle is the Lord...*’, Oxford, 1982, frontispiece.
52. “Geometry and Experience”, the 1921 lecture to the Prussian Academy of Sciences, *Ideas and Opinions*, New York, 1954, p. 233.
53. Refer to Denis Brian, *op. cit.* p. 370.
54. “Über den Gegenwärtigen Stand der Feld-Theorie”, *Festschrift zum 70. Geburtstag von Prof. Dr A. Stodola*, Zürich, 1929, pp. 126-132.
55. *Ibid.*, p. 126: “Wir wollen nicht nur wissen wie de Natur is (und wie ihre Vorgänge ablaufen), sondern wir wollen...wissen warum die Natur so and nicht anders ist.”
56. Einstein, *Ibid.*, p. 127.
57. “The Rediscovery of Time”, *Zygon, Journal of Religion and Science*, December, 1984, Vol. 19, No. 4, p. 444, with reference to T.S. Eliot, “Burnt Norton”.

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