

Judaism and Science: A Synergistic Symbiosis

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Introduction: How Judaism influenced Science

The most important and best-known statement in Judaism is its affirmation of staunch monotheism:

Sh'ma Yisrael HaShem Elokenu HaShem Echad.

Hear O Israel, the Lord Our God, the Lord is One. [Deuteronomy 6:4]

The prophets later reinforced this message. God says through the prophet Isaiah:

Ani Hashem, ve'en 'od [I am the Lord, and there is none else];

Zullati en elohim [beside me there is no god]...

Yotzer or uvoreh choshech [I form the light and create the darkness],

'Oseh shalom uvoreh ra' [I make peace and create evil;];

Ani HaShem 'oseh chol elleh [I am the Lord who does all these things]

[Isaiah 45:5,7]

I may surprise you by telling you that monotheism gave rise to a scientific attitude. Indeed, science and Judaism are complementary and mutually reinforcing, rather than being in opposition. Science has challenged our understanding of the universe: How the world may have come into being, how it may end, the nature of reality, the role of the observer, the relativity of space and time, the uncertainty principle, etc.

Judaism had a role in shaping scientific thought. After all, well beyond its beliefs and its teachings, Judaism nurtures basic attitudes, original ways of looking at the world. These attitudes transcend words and ritual and are transmitted through the generations even by secular and assimilated Jews. They are the essence of Judaism. Three Jewish attitudes helped create the climate into which modern science was born. Let us explore them one by one.

First, the Jewish notion that God is One. It gave birth to the scientific quest to unify our understanding of nature, to synthesize everything, to bring all observations and experimental results under a single theory.

Consider this. Physicists have discovered four natural forces: Gravity, electromagnetism, the weak nuclear force, and the strong nuclear force. Each describes its own set of phenomena. Physicists

have tried for decades to unify them into a single force, which they call the Unified Field Theory. Einstein spent his last 30 years looking for it. In 1979, three physicists got the Nobel Prize for unifying electromagnetism and the weak nuclear force. (I should tell you I am a physicist.)

The driver of these endeavors is faith in the unity and simplicity of the laws of nature. The notion that “God is One” has taught scientists to look for hidden connections that point to common origins. Note that it is not what comes naturally to mind. It must be learned and experienced. When one witnesses good and evil, it is natural to conclude in the existence of a God of Good and a God of Evil, forever struggling for control. It is natural to believe there is a god for every part of human experience: A god of war, a goddess of love, a god of the sea, a goddess of agriculture, etc. Looking for unity goes against the natural impulse.

Second, the Jewish notion that God must be imitated. It gave birth to the scientific notion of trying to imitate nature rather than explain it.

In describing Himself in the Torah, God does not say “I am the Lord your God, who is omniscient, omnipotent, omnipresent, eternal, etc.”, but rather “I am the Lord your God who took you out of the land of Egypt” [Exodus 20:2] – “who extends mercy to the thousandth generation, who is slow to anger, who forgives iniquity, transgression and sin, yet who will not clear the guilty”, etc.. [Exodus 34:6-7]

In other words, God describes himself by what he **does**, not by what he **is**. When Moses asks God at the burning bush, “What is your name?”, God answers:

Ehyeh asher ehyeh -- I am what I am. [Ex. 3:12]

Judaism has no theology, which literally means knowledge of God. Maimonides, the 12th-century Jewish philosopher, wrote that you can talk about what God IS NOT, but not about what God IS.

In Judaism, we are enjoined to imitate God by following commandments, rather than explain God by believing certain statements about God's nature. God says in the Torah:

K'doshim tihyu ki kadosh ani HaShem elokechem

You shall be holy, for I, the Lord your God, am holy. [Lev. 19:2]
In other words, "Imitate me by following my commandments". And we respond:

Naaseh v'nishma -- We will do and we will listen. [Ex. 24:7]
We do not say, 'We will believe'. Maimonides tried to formulate a Jewish creed with his thirteen principles of faith, but he encountered resistance because, although valid, his principles are not a test of observance.

Likewise, scientists attempt to *imitate* nature, rather than explain it. Their concern is not the *why* but the *how*. They observe nature and imitate it by building theories that account for their observations. These theories predict future behavior, which helps them build useful devices. Their aim is to reproduce, predict, and use nature, not explain it. Indeed, "to explain" means "to establish a connection with common sense, reason, logic, or even intuition". Science does not do that because it must deal with observations that are too weird for that.

For example, relativity theory says that what is five inches to one person can be five miles to another; what is five minutes to one person can be five hours to another. Quantum mechanics tells us that there is a built-in randomness in the world, a fundamental uncertainty that can never be resolved by more accurate measurements. It tells us that there is no reality independent of us, only probabilities, and that the observer creates reality by the act of observation. This implies that we are, in a very real sense, God's partners in creation.

The scientist only wants to know: "Does the theory make correct predictions?" not: "Does it make sense?" The physicist Feynman, who won the Nobel Prize for quantum mechanics, once said that the purpose of science is to answer the question, "If I do this, what happens?" Science cannot "prove" anything. If one event always comes before another event, it does not prove that the first caused the second. A cause-to-effect relationship can *never* be proved. It's not just difficult, it's impossible. So the scientist can't answer "Why?" He can formulate theories, but they will remain theories. Once a theory, always a theory. Science describes how and religion speculates on why. Science and religion have a complementary relationship, not an antagonistic one.

Third, the Jewish notion that no idolatry is allowed. It gave birth to the scientific notion that no theory is beyond scrutiny and doubt.

Judaism is passionately opposed to idolatry in all its forms. The net effect is that Jews are prone to criticize, to doubt, to be irreverent towards authority, to be iconoclasts, because even though “no idolatry” means “no idols of wood and stone”, it also means “no idols of the mind”.

Likewise, in science, Einstein challenged entrenched beliefs about time and space. Quantum physicists threw out the principle that two identical experiments, performed under exactly the same conditions, must yield identical results. Scientists discard theories when facts lead to new ones. There are no sacred cows in science. Feynman once said: “The most fundamental part of my being is to doubt.” It doesn't bother him not to know; but it would bother him not to doubt. The 19th-century French playwright Edmond Fleg wrote: “I am a Jew because Judaism does not require me to give up any part of my mind.” Some people like to say, “The truth shall make you free.” But in reality, if you think you have the truth, you are not free, but a slave to that truth. Rabbi Abraham Joshua Heschel said:

The aim of Jewish piety lies ... in the maintenance and fanning of a discontent with our aspirations and achievements, in the maintenance and fanning of a craving that knows no satisfaction. Thus, Judaism ... teaches man never to be pleased, to despise satisfaction, to crave for the utmost, to appreciate objectives to which he is generally indifferent. It plants in him a seed of endless yearning, a need of spiritual needs rather than a need of achievements, teaching him to be content with what he **has**, but never with what he **is**... **All that is creative stems from a seed of endless discontent.** [Heschel, in *Man Is Not Alone*]

Perpetual unhappiness with the status quo is a precondition for all progress.

Creation: The beginning of the world

The Torah opens with the beginning of the world. We are treated to the majestic picture of Divine Creation:

Bereshit bara Elokim et ha-shamayim ve-et haaretz --

In the beginning God created the heaven and the earth. And the earth was without form, and void; and darkness was upon the face of the deep...
And God said, Let there be light. And there was light...
And there was evening and there was morning, one day...
[Then God created land and sea, plants, stars, planets, fish, birds, reptiles, cattle, all manner of animals, and finally people] ...in His own image... male and female He created them...
And God blessed them and... said to them, Be fruitful and multiply, replenish the earth and subdue it, and have dominion over... every living thing...
And God saw every thing that he had made, and, behold, it was very good.
And there was evening and there was morning, the sixth day. [Genesis 1:1-31]

Let us discuss creation from both a traditional Jewish perspective and a modern scientific perspective, and compare the two.

Creation is central in Judaism. The Shabbat morning service focuses on creation. We say:

Baruch she'amar ve-hayya ha-olam

Blessed is He Who spoke, and the world came into being

We call God:

Yotser or uvoreh choshech, oseh shalom uvoreh et ha-kol

He Who forms light and creates darkness, Who makes peace and creates everything

In the Amidah, we call God

Koneh ha-kol (Creator of everything).

We sing *kEI Adon*, the song of creation, which calls God "*kEI Adon al kol ha-maasim*" ("Master of all creations"), and mentions twelve different sources of light.

I find it most remarkable that in the past hundred years alone, one scientific discovery after another came to validate the Torah's account of creation. Scientists, who have a natural anti-religion bias, always managed to claim the opposite was true before those discoveries were made.

First, let's look at the first event:

God said, Let there be light. And there was light. [Genesis 1:3]

This wording implies that our world had a sharp, specific beginning. Now, until 1965, most scientists supported the steady state theory, which said the universe had no beginning and no end, has always been here and always will be, forever unchanging. Then, in 1965,

new observations confirmed that our world had a sharp, specific beginning, which scientists called the “Big Bang”. They were actually able to hear the noise left over from that first gigantic explosion, and ascertain that that noise fills the whole universe! And science now supports the account in the Torah.

Second, take creation itself. The word means making “something out of nothing” -- “*Ex nihilo*”. “Nothing” was always understood to mean nothing material, nothing you can see, touch, or perceive with your senses. Scientists were convinced that matter cannot appear out of nothing. Then Einstein came, with his theory of relativity, and said that $E = mc^2$, that matter is just a condensed form of energy, and that visible matter CAN appear out of invisible energy. In the laboratory, physicists can create pairs of particles from pure energy, from “nothing” if you will. All of a sudden, a particle and its antiparticle appear. They even *call* it “pair creation”. Conversely, when a particle meets its antiparticle, the opposite occurs. They both disappear in a flash of energy. It's called “pair annihilation.”

Was creation a miracle? The laws of the universe are statistical in nature. The universe has a certain amount of randomness built into its very fabric. The outcome of experiments in the subatomic world can only be predicted in terms of probabilities, not certainties. There is an “uncertainty principle” that denies us total accuracy in measurement. Even in the macroscopic world statistical laws apply. Winds can blow in unexpected directions with unexpected force. Weird variations -- call them miracles if you wish -- are not only allowed, they are *required* to happen every once in a great while.

Third, was the earth empty at first, then life came? Yes. The Torah and science agree on that too. Does science conclude that the evolution of life follows the order given in the Torah: Plants, then fish, birds, reptiles, mammals, and finally people? Roughly speaking, yes, in the sense that life forms became more and more complex.

Fourth, let's tackle the issue of time. Science tells us that the universe is 13.8 billion years old. The evidence for that is twofold. First, dating techniques tell us that some fossils found inside the earth are millions of years old. Second, we calculate that some stars are

billions of light-years away. This means that it takes billions of years for their light to reach us. So what we see today in the sky can be billions of years old.

[illegible]

Can we verify this? Yes. It's called the twin effect. It is popularized as follows. Two twins are twenty years old. One stays on earth. The other goes off to explore the universe in a very fast spaceship, then returns to earth. For him, his journey lasted five years, and he looks and acts 25. But he is astonished to see that his twin brother looks and acts 80 years old, and has actually experienced a full 80 years! Did we actually do this? Of course not. But we did the equivalent in the laboratory. We created particles that have a very short lifetime when they are at rest. But when we accelerated them to very high speeds, we found that their lifetimes increased, and by just the amount predicted by Einstein!

Fifth, if there was a Big Bang, what came before it? The Torah doesn't say, and science can't say! What does Einstein's relativity say? It says that all measurable quantities at the time of the Big Bang become infinite, which means that the theory fails at that point. It's the only physical theory that predicts its own downfall! All other theories can calculate what happened to a system in the past, or what will happen to it in the future. But when we use relativity to extrapolate the known universe backwards in time, we encounter an impenetrable wall right at the Big Bang!

The Talmud told us this in its own language:

כל המסתכל בארבעה דברים רתוי לו כאילו לא בא לעולם: מה למעלה, מה למטה, מה לפניו ומה לאחור

Kol hamistakel be-arbaa dvarim ratui lo k'illu lo ba laolam: Mah le-maala, mah le-mattah, mah le-fanim, umah le-achor.

Whoever speculates about the following four things, it would have been better for him if he had never come into the world: What is above, what is below, what was before, and what will be after. [Hagigah 2.1 -- 11b]

It is a warning that you will likely break your teeth if you try! The Meiri, in 13th-century Spain, says that this matter is above our comprehension. The Midrash [Ber. R. 1:10] even tells us that this curtain is suggested by the first letter in the Torah, *bet*. *Bet* is closed on three sides, and is open only towards the Torah itself. So don't try to find out what happened before it, or above it, or below it. And one can add that the Torah ends with a lamed, which can be interpreted as a wall: Don't try to find out what will happen after it either. Just concentrate on studying IT!

If we can't speculate on what came “before” creation, can we at least say that there was SOMETHING before creation? Yes, we can. The Midrash and the Zohar tell us that, before creating our world, God created many worlds and destroyed them, because He did not like them:

Rabbi Abbahu said:... the Holy One, blessed be He, went on creating worlds and destroying them until He created [ours], and then He said: This one pleases Me; those others did not please Me.

Rabbi Pinchas said: The proof... is [the line in Genesis]:

And God saw ALL that He has made, and behold, it was very good.

[Gen. 1:31]

[ALL that He has made means: ALL the worlds, good and bad. And behold: Only OUR world “was very good”.] [Genesis Rabbah 9:2]

Indeed, the prophet Isaiah says, in God's name:

Behold, I create new heavens and a new earth; and the old ones shall not be remembered, nor come to mind. [Isaiah 65:17]

In the siddur (the prayerbook), we call God “*Adon Olam*”, “Lord of the World”. But we also call Him “*Adon ha-olamim*”, “Lord of the Worlds” [plural]. This could mean “this world and the next”, but also the destroyed worlds we just talked about. Rabbi Levi Yitzhak of Berdichev, the 18th-century Hassidic sage, insisted that these worlds still exist, somewhere. He said, “Everything God created exists forever and never ceases to be.”

Finally, the sum of the lives of all these worlds could well be 13.8 billion years, thus reinforcing the Torah in another way!

But if that is so, why would God not want us to know about these earlier worlds, in some detail? The Midrash explains: If a king builds a sumptuous palace on top of a sewer, or a dung heap, or a pile of trash, he does not want the matter known, and we must respect his wish. [Genesis Rabbah 1:5]

Now, how do we know we are not in a world that God will also destroy in the future? Well, up to a few years ago we thought we were. We thought that the initial Big Bang would cause the universe to expand for some time, then stop expanding and start imploding under its own gravity, and finally disappear into nothingness billions of years from now. This was called the “Big Crunch”. Today, however, the evidence shows that the universe is accelerating its expansion, showing no sign of slowing down, so no “Big Crunch” is predicted.

Sixth and last, let me tackle the creationists’ arguments. In fairness to the most thoughtful among them, it is not aversion to science that moves them, it is not Bible inerrancy, and it is not disgust at the thought of descending from apes. Their real problem is the notion that the world is run by survival of the fittest, by the law of the jungle, by might making right. They ask: What about compassion, mercy, love? We spend a lot of time and money lifting up the fallen; helping the poor, the sick and the weak. We don't want to abandon them. Are we really going against God's will when we do that? That's what troubles them, and the argument is sound.

The Jewish answer to them is in the Zohar and the Midrash. The Zohar says that God destroyed the previous worlds because they would not follow the Torah. He asked, and no one would. In our world, only Israel did:

The Torah is the salvation of the world... [We must understand that] God created worlds and destroyed them in the following way: Those who do not keep the precepts of the Law [destroy themselves of their own account]. It is not that God destroys His own works, as some fancy. For why indeed should He destroy His own children? [Zohar Bereshit 1:25a]

So a world without Torah will destroy itself, without God having to intervene. Along those lines, the Midrash notes that “*bereshit*” can

also mean “with *reshit*”, that is “with the beginning”, “the beginning” being the Torah. So the first phrase should read: “With the beginning (that is, with the Torah) God created the world.” [Gen. R. 1:1]

So when the world is ruled purely with justice, with cold equations, with a master plan unfolding no matter what, it will not endure. It needs the Torah with its “just right” mixture of justice and mercy. So survival of the fittest *is* a valid concept, but it’s only part of the story. Other parts are love, kindness, compassion, mercy; and they are not reflected in our physical theories.

Let me conclude. Am I trying to say that the Torah must be interpreted literally? No, of course not. Maimonides, among many others, argued that the Torah is intended to be ethical teachings, not science. He wrote:

Those passages in the Torah, which, in their literal sense, contain statements that can be refuted by proof, can and must be interpreted otherwise. [Rambam, Guide to the Perplexed, 2:25]

I *am* saying that we must not be too quick to laugh at the ignorance of our ancestors and the content of our tradition. Some things that so-called “enlightened minds” find laughable may turn out to be true. As Einstein put it, science has clearly shown that the world is not only stranger than we imagine, it is stranger than we CAN imagine.

In general, commentators have not been concerned with whether biblical events occurred as described in the Tanach, but only with what teachings can be extracted from the narrative. For example, the Talmud asks:

-Why did God start humanity with only one person?

One answer is: To teach him that he who destroys one person is as if he had destroyed an entire world, and he who saves one person is as if he had saved an entire world.

Another answer: So no one can say, “My ancestor was greater than your ancestor.” People should realize they are all related and behave as one large harmonious family.

Another reason is so heretics could not say there are many gods, and each created his own “man”. [Sanhedrin 37a]

(2) Why was man created last?

One answer is: If Adam had been created first, the heretics would claim: It was Adam who created everything else.

Another answer is: So that, if a man becomes too proud, he may be reminded that God created the insects before him.

A third answer: So he could immediately engage in fulfilling commandments, in this case the observance of Shabbat.

A fourth answer: So everything would be ready for his use as soon as he arrived, him being the most important creature. [Sanhedrin 38a]

These are valuable teachings, whether one accepts the biblical narrative at face value or not.

The end of the world

We covered the relationship between science and Judaism in the first endpoint, creation. Let us now turn to the other endpoint: The end of the world.

The first time mention is made of the end of the world is in the Book of Genesis, when the patriarch Jacob is on his deathbed. He calls his sons and tells them:

הָאֶסְפִּי וְאֶגִּידָה לָכֶם אֶת אֲשֶׁר-יִקְרָא אֲתֶכֶם בְּאַחֲרֵית הַיָּמִים

Come together that I may tell you what will happen to you at the end of the days (*acharit ha-yamim*). [Gen. 49:1]

So we expect to find out what will happen at the end of the days! But instead, Jacob proceeds to bless his children, without failing to criticize some of them, to be sure, and says nothing about the end of the days! Why is that? Why does the Torah announce something, then doesn't deliver? Something must have happened. The Talmud answers that God did not want him to reveal it. [Pesachim 56a]

We don't know why, but we can speculate: What would revealing the secret have achieved? If Jacob's sons had known that the Messiah would not come for at least 3,500 years in their future, as we now know, they might have gotten discouraged and given up. Perhaps that is why God intervened to silence Jacob, and the Torah included this incident to teach us that this is something we need not know.

Our Sages later told us that by "end of the days" Jacob meant, not the end of life and the universe, but the arrival of the Messiah, who will usher in a time when all will live in peace and recognize God,

when all the Jews will move to the Land of Israel and rebuild the Temple. This is called the “final redemption”. At that time, according to the prophet Isaiah, all the nations:

“...shall beat their swords into plowshares and their spears into pruning hooks; nation shall not lift sword against nation and they shall not learn war anymore.” [Isaiah 2:4]

But this period is not to last forever. The material world will end. The Talmud says:

The world is [set] to exist for 6,000 years. In the first 2,000 there was desolation [that is, no Torah]; [in the next] 2,000 years the Torah flourished; and the next 2,000 years is the Messianic era, but because of our many sins [the Messiah is delayed and many of] these years have been lost. [Sanh. 97 a-b]

We are in the year 5778. So the Messiah should arrive sometime in the next 222 years, and his era should last until the Jewish year 6000, which is the secular year 2239, when the material world will end.

Perhaps that is the time the prophet Isaiah refers to when he quotes God as saying:

For, behold, I create new heavens and a new earth; and the former shall not be remembered, nor come to mind. [Is. 65:17]

So the Messianic period will blend in with the World to Come, *olam haba*, when the dead will come back to life and enjoy a time that is “all Shabbat” -- *yom shekulo Shabbat*. To be sure, the Bible tells us that this period will come after a horrendous world war led by King Gog from the Land of Magog, during which good will obliterate evil.

[Ezekiel 38-39; Zechariah 21:2, 14:23; Sukkah 52, Sanhedrin 97, Sotah 49] The only unknown in Jewish tradition at this point is *when* all this will happen.

Now, let us turn to science. What does science say about the end of days? Well, astronomical observations tell us that our sun is an ordinary star, meaning that it will age and eventually die like all other stars. The earth will have to die with it. So we will have to migrate to other planets to survive. Those planets will also eventually die. Physics tells us that the end of the world is expected to come from the second law of thermodynamics. This law states that entropy always increases, which means that the world moves inexorably from order to disorder. If you create some order over here, it is compensated by even more disorder over there. (I am sure you have all experienced that!) So there will come a point when, inevitably, all

the atoms in creation will be milling about aimlessly, all carrying the same amount of energy. This means that there will be no concentrations of mass and energy that might bring order. It is called the "heat death of the universe". It is called that because everything will be at the same temperature. It will not happen for a very long time -- at least 100 billion years. It will be a very gentle end, not a cataclysmic one. Unless we learn how to reverse entropy, which today does not appear feasible, we cannot avoid it.

Let me interject an intriguing observation. Entropy is a measure of how much freedom of movement there is. The law tells us that there is a basic impulse in the universe to maximize freedom of action. And how much more freedom can there be when individual atoms are totally free to move around, when they are not constrained by any ties to other atoms, when they are not forced to be part of a larger structure? So we see that "freedom" is a very fundamental yearning in nature, and not just for human beings. Inanimate objects also want freedom!

The following is worth noting. Before the 1960s, the preferred theory among scientists was that the universe has always existed and always will. This was called the "steady-state" theory. Then came observations, in the 1960s, which confirmed that the universe started with a Big Bang 13.7 billion years ago. But way back in 1862, a century earlier, some physicists wondered: If the universe has always existed, as we believe, why isn't it in heat death *now*? The fact that it isn't implies that the universe must have had a beginning. This thought could have led them to deduce the Big Bang, thereby validating the account of creation in the Torah. But it didn't. What a missed opportunity! Could there be an anti-religion component in this missed opportunity?

Scientists have thought of other scenarios, which all end up with the demise of the material world. When observations showed that the universe is expanding, it was thought that the expansion would slow down at some point and eventually stop, and gravity would make everything implode back into a single point. It would be a reverse Big Bang, with no possibility even to leave a note behind. They called it the "Big Crunch". Now, observations show that the expansion of the universe, far from slowing down, is accelerating at a speed faster

than light. This means that the galaxies are moving faster and faster away from one another, to the point where one day the density of matter will be so low as to not allow any life to continue. They call it the “Big Freeze”, and it will accelerate the “Heat Death” mentioned earlier.

Now, how do we reconcile the Jewish account with the many scientific accounts? Simple: They all agree that the material world is not forever. It is going to end. As for what will happen after it, science is silent, but the Talmud [Berakhot 17a] tells us that after the material world, we will enjoy a spiritual world, where our needs and yearnings will be totally different, in a way that we cannot comprehend today. Maimonides summarizes it as follows:

There are no bodies and no bodily forms in the World to Come... Nor does there occur there any of the events which occur to the human body in this world, such as sitting, standing, sleeping, death, distress, laughter, and so forth, ... no eating or drinking or procreation. The righteous will sit with their crowns on their heads and bask in the radiance of the Divine Presence... There is no way for us in this world to know or comprehend the great goodness which the soul experiences in the World to Come, for in this world we know only of material pleasures, and it is these that we desire. [Rambam, Yad, Teshuvah 8]

Isaac Asimov, the science-fiction writer, wrote a short story called “The Last Question”. That question was: How can we reverse entropy? In the story, successive generations face more and more entropy, more and more disorder around them, until the universe dies a heat death. At that point, a voice says: “*Yehi or* -- Let there be light!”

The poem *Adon Olam*, which we sing at end of services, echoed that same sentiment when it was written in the 11th-century. It says:

Ve-acharei kichlot hakol levado yimloch nora.

And when everything shall cease, God will still reign in majesty.

Free will, Judaism and quantum physics

Let us now tackle how the Jewish notion of free will interacts with quantum mechanics, the foundation of the edifice of modern science.

In the Torah, God tells us:

Re'eh, anochi noten lifnechem hayyom brachah uklalah.

See, I set before you today a blessing and a curse. [Deut. 11:26]

Later, God says, again:

Re'eh, natati lefanecha hayyom et ha-chayyim ve-et hatov, ve-et hammavet ve-et hara'.

See, I have set before you this day life and good, and death and evil. [Deut. 30:15]

And later still, God repeats the idea, and follows with a recommendation:

Ha-chayyim ve-hammavet natati lefanecha, ha-brachah vecha-klalah.

Uvacharta bachayyim lemaan tihyeh atta vezar'echa.

I have set before you life and death, blessing and curse.

Choose life, that you and your seed may live. [Deut. 30:19]

The message is clear: We have free will. (In Hebrew, *bechirah chofshit*.) We have choices, and we can freely choose among them.

Maimonides, the 12th century Jewish Sage, writes:

Freedom of choice has been granted to every man. If he desires to turn toward a good path and be righteous, the ability to do so is in his hands; and if he desires to turn toward an evil path and be wicked, the ability to do so is in his hands... For if God were to decree that a person be righteous or wicked..., how could God command us... "do this" and "do not do this"...? What place would the entire Torah have? And by what measure of justice would God punish the wicked and reward the righteous...? [Rambam, Mishneh Torah, Laws of Repentance 5:1-3]

Every person is fit to be as righteous as Moses or as wicked as Jeroboam, wise or foolish, kind or cruel,... and may tend, of his own free will, to whichever side he pleases. [Rambam, Mishneh Torah, Laws of Repentance 5:2]

Jewish teaching is that we were created with a good inclination and an evil inclination -- the *yetzer ha-tov* and the *yetzer ha-ra'*. We are free to pursue either and enjoined to pursue the first one. In the Talmud, Ben Zoma says:

Ezehu gibor? Ha-kovesh et yitzro

Who is mighty? He who subdues his evil inclination. [Pirkei Avot 4:1]

Yet, at the same time, we are taught that God is omniscient, that is, all-knowing, that He knows the future in all its details. More than that, some Sages, such as Nachmanides, the 13th century Spanish Sage, held that the Torah itself contains not only the general outlines of

world history, but the precise details as well. The Vilna Gaon, the influential 18th-century Lithuanian Sage, writes:

The rule is that all that was, is and will be, until the end of time, is included in the Torah from [the word] “Bereshit” [in the beginning] to “l'enei kol Yisrael” [at the end]. And not merely in a general sense, but including the details of every species and every person individually, and the most minute details of his life from the day of his birth until his death. [Vilna Gaon on Sifra d'Tzniusa]

In the Talmud, Rabbi Akiva sums it up by saying:

Hakol tzafui, ve-harshut netunah

Everything is foreseen, and freedom of choice is given. [Pirkei Avot 3.19].

So we ask: If God knows what we are going to do, how can it be said that we have a choice? Why the Torah and the exhortations to be righteous if God predetermined exactly whether you will be righteous or not? If everything that happens in the universe is programmed in advance and simply unfolds, with no variations allowed, what is the point of it? What is its purpose? Such a scenario is profoundly unsatisfying and disappointing, not to say depressing. Are we mere robots unwittingly following a script, with only the illusion of free will? That is what even scientists actually believed in the 19th century. It is called “determinism”.

I will suggest two answers to these questions.

First, we have to deal with God's infinity attributes. We are taught that:

- God is omnipotent (He can do anything),
- God is omniscient (He knows everything),
- God is omnipresent (He is everywhere),
- God is eternal (He has always existed and will always exist),
- God is perfect,
- etc.

These infinity attributes reflect the influence of Greek philosophy, but they are not in the Torah. In the Torah, God does not say, “I am the Lord your God who is omnipotent, omniscient, etc.” Rather, God says:

I am the Lord your God who took you out of the Land of Egypt; who extends mercy to the thousandth generation; who is slow to anger; who forgives iniquity, sin and error; who does not remit all punishment. [Ex. 20:2; Deut. 5:10, Ex. 34:6-7]

These are among the 13 attributes we recite on the High Holy Days and other times.

In other words, God describes himself by what he **does**, not by what he **is**. When Moses asks God at the burning bush, 'What is your name?', God simply answers, '*Ehyeh asher ehyeh*' -- 'I am what I am' or 'I will be what I will be'. [Exodus 3:14] This means, “the only thing you can say about my nature is that I am, I exist”. So Maimonides concluded that you can talk only about what God **is not**, but never about what God **is**. This is called “negative theology”.

In addition, the infinity attributes quickly create paradoxes. Can God create a boulder so heavy that even He cannot lift it?

-If so, then God is not all-powerful, because He can't lift it.

-And if not, then God is still not all-powerful because there is something He cannot create.

So we conclude that God intentionally inserted limits on what can be done in the universe, and made these limits apply to Himself as well.

This brings us to the **second answer**. In the past century, physicists have been able to establish that there is an inescapable randomness in nature. It is called the uncertainty principle. It says that we can predict the probabilities of certain things happening, but only their probabilities. We cannot know with certainty which ones will actually occur. This uncertainty is not a limitation on our instruments or capabilities, but built into nature itself. This theory is called quantum mechanics. We have not been able to find any way around it. We cannot discard it, because it is the most accurate theory ever devised, even more accurate than gravity. We use it every day. Without it, we would not have transistors, lasers, electron microscopes, MRIs, microchips, the Internet, and many other wonders of modern technology.

So now we understand what Rabbi Akiva's dictum really means: “Everything is foreseen, and free will is given.” It means: “Everything [**that there is to foresee**, namely the probabilities of occurrence,] is foreseen, and [therefore] free will is given, [because these probabilities are not certainties.]” So the future is really unknown, even to God, because that is the way God built the world.

This is not a limitation on God's power. To use an analogy, let's say you invent a board game that uses dice. You are the creator, you made the rules and built the game, but you chose to include rolls of dice, so that even YOU cannot predict how the game will evolve or who will win. This is not a limitation on your power to create a game. You could have created a game where chance plays no part, such as chess or checkers, but chose to insert an element of randomness instead. God did the same thing when He created the world. But He also gave us tips to improve our chances to win in spite of the randomness. This is called the Torah. The Torah is God's strategy tips to increase our chances of winning despite the dice. We are taught that "winning" means "earning a place in the World to Come".

So God does not know the future. When God is angry at us or pleased at us in the Torah, it is not just a show to impress us, as it would be if God knew what we were going to choose all along, but genuine anger or pleasure, because He did not know what we would choose. Note that you can still say that God is omniscient, but now the word means "knowing all that there is to know". The future is simply not there for anyone to know.

Note that Rabbi Akiva's dictum is always mistranslated as "Everything is foreseen, YET free will is given." The "yet" implies that the two parts are in opposition to each other. But he did not say that. The Hebrew says "Everything is foreseen, AND free will is given." The two parts are not in opposition.

An objection can quickly be raised: What about the prophecies, when God predicted that certain things would happen, and sure enough they did? For example, God predicts to Abraham the enslavement of Israel in Egypt:

Know for certain that your offspring will be strangers in a strange land, and will be enslaved and afflicted for four hundred years. But know with equal certainty that I will judge the nation that enslaved them, and that afterwards they will leave with great substance. [Genesis 15:13-14].

How do we square these prophecies with the notion that God does not know what will happen? Simple. Prophecies are fulfilled when God chooses to intervene to make them happen. Just as you can remove the dice from your board game anytime you want and

introduce temporary new rules, so God can temporarily suspend randomness to force something to happen. But most of the time God chooses not to intervene, and lets matters play themselves out, free will and all.

Interestingly, Jewish mysticism seems to accept this view, using its own terminology. The Kabbalah introduces the idea of *tzimtzum*, which literally means “constriction”. It teaches that God “constricted” his infinite essence to create an independent world. This constriction made free will possible, and allowed people to earn their entry in the World to Come. *Tzimtzum* seems to be quantum mechanics by another name.

To be sure, the exact connection between free will, consciousness, and quantum mechanics is not completely understood, and is still being debated. The problem is that when a laboratory experiment can have several possible outcomes, and the experimenter makes an observation and brings one of them into reality, he does not choose it, at least not consciously. It just happens. Our mental powers are still largely unknown and uncontrolled.

Free will can and does lead to bad choices. In the Midrash, Israel complains about having free will for this reason, saying:

Israel said: “Lord of the Universe! If a potter leaves a pebble in the clay and the jar leaks, is the potter not responsible? You have left in us the evil inclination, which causes us to sin. Remove it, and we will do your will!”
God replied: “This I will do in the Time to Come. [Exodus Rabbah 46:4]

The implication is that in the next world we will automatically do all the right things. But nevertheless, in this world, most of us are happy to have free will, and happy to feel that the unknown future belongs entirely to us and to the choices we make. As reported by the prophet Jeremiah,

V'esh tikvah l'acharitecha, n'um HaShem

And there is hope for your future, says the Lord. [Jer. 31:16]

Is everything for the good?

Let us now turn to the Jewish teaching that God is always working for the good of humankind, in spite of the occurrence of evil deeds and tragedies. How does it relate to science?

From the **religious angle**, everything God does is good:

-Vayyar Elokim et kol asher 'asa v'hinne: tov me'od

And God saw every thing that He had made, and, behold, it was very good. [Genesis 1:31]

-Tov HaShem lakol, verachamav 'al kol maasav

The Lord is good to all; and His mercies are over all His works. [Psalms 145:9]

An example of this attitude is first-century rabbi Nachum ish Gamzu. He was severely afflicted, yet always optimistic. No matter what happened to him or around him, he would say: "*Gam zu l'tovah* -- This, too, is for the good". He always saw a silver lining:

It is related of Nachum of Gamzu that he was blind in both his eyes, his two hands and legs were amputated, his whole body was covered with boils, and he was lying in a dilapidated house on a bed whose feet were standing in bowls of water to prevent the ants from crawling on to him. Why was he called Nachum of Gamzu? Because whatever befell him he would declare, "*Gam zu l'tovah* -- This, too, is for the good." [Taanit 21a]

His disciple Rabbi Akiva, who is regarded by many as the greatest rabbi in the Talmud, followed in his footsteps and said "*Kol da'avad rachmanah litav avad* -- All God does is for the good":

...It was taught in the name of Rabbi Akiva: A man should always accustom himself to say 'Whatever the All-Merciful does is for the good'. [As an example, consider] the following incident.

Rabbi Akiva was once traveling along the road. He came to a certain town and looked for a place to stay but was turned away everywhere. He said 'Whatever the All-Merciful does is for the good'.

He went and spent the night in an open field. He had with him a rooster [to wake him up in the morning], an ass [to carry his luggage], and a lamp [to study Torah at night]. A gust of wind came and blew out the lamp. A weasel came and ate the rooster. A lion came and ate the ass. He said 'Whatever the All-Merciful does is for the good'.

That same night some bandits came and carried off the inhabitants of the town. He said: Did I not say to you, 'Whatever the All-Merciful does is all for the good?' [The light from the lamp or the sounds from the rooster or the ass would have revealed my location to the bandits and I would have suffered the fate of the town's inhabitants.] [Berachot 60b]

It is noteworthy that the rabbis said “this, too, is for the good”, not “for the best”. They are not the same. The “best” option could just be the “least bad” option, but not a “good” option. But the rabbis meant what happens is “positively good”.

Now, from the **scientific angle**, we observe that nature is always optimizing:

- Principle of least time: Between two points, light takes the path it can cross in the least time (e.g., broken line in refraction -- objects at bottom of a pool appear closer to the surface than they are).
- Soap shapes form so as to minimize surface area: When two metal strings are inserted together in a soapy solution then pulled out and apart, the soapy surface that joins them is the surface that has minimum area.
- Principle of least action: The path followed by a body subject to forces is the path that minimizes a function called the “action”.
- Large heavenly bodies are spherical because the sphere has minimal area for a given enclosed volume.
- Entropy, the overall degree of disorder in the universe, always increases towards its possible maximum.
- Natural evolutionary processes maximize the probability of survival of a species in a changing environment.

Some conclude that, this being the case, why not assume that nature optimizes **everything**, including matters where humans are involved? This is where the word “optimism” comes from. The philosopher Leibnitz believed that “Everything is for the best in the best of all possible worlds.” (He was satirized by Voltaire in his novel *Candide or Optimism*.)

But the big question is: What function, exactly, is God optimizing? That is unknown. Who is this optimization tailored to: The individual, the community, the country, the world, the universe, something else entirely? We don’t know. These are not all the same. The greater good of the world might require that some individuals suffer more than others. Judaism acknowledges this uncertainty, but teaches that it all averages out in the World to Come.

Why can’t we always see the good? One answer is our limited understanding. A primitive man in dentist’s chair or surgeon’s table only knows he is being hurt -- he does not see it’s for his own good in the long term. Note that Moses could not see the good in God’s actions either:

Moses returned to God and said: "My God, why have You done evil to this people? Why have You sent me? For since I came to Pharaoh to speak in Your name, he has done worse to this nation; and You have not saved Your people!" (Exodus 5:22-23).

Can one always find a silver lining? Yes, especially when there is plenty of uncertainty:

- The destruction of the Temple led to a Judaism centered on synagogue, prayer, study, and spiritual matters.
- The Diaspora helped us learn new skills from host countries.
- The expulsion from Spain led us to do better elsewhere, seed our knowledge, and bring new skills to the world at large.
- The Holocaust led to the world allowing creation of State of Israel.
- The State of Israel is under siege and surrounded by haters, but this:
 - Keeps the country together
 - Increases determination to keep state Jewish
 - Avoids intermarriage with Arabs, with resulting explosion in number of children with mixed parentage, uncertain identity, with little or no Jewish commitment, or even antisemitic, who might annul the Law of Return
 - Avoids possible civil war between secular and religious factions. The Talmud says the "*sin'at chinam*", senseless hatred, brought down the Second Temple.
- Without the expulsion from Spain in 1492, my parents would not have met and I would never have existed.
- If I had not been forced out of Egypt in 1967, I would never have met my wife, had my children and grandchildren, and led as satisfying a life.

Many strongly object: Even so, it's not worth it. Counter: Nobody says it was worth it or it's something to plan for, but after it happened, it is appropriate to look for the good. Another objection: This attitude may lead to acceptance of looming bad events and not doing much to counter them before they happen, since they are ultimately "for the good".

Consider the event of Jewish slavery in Egypt, a calamity God sent us without us doing anything wrong. Jacob and his clan were 70 strong when a famine forced them to go to Egypt, invited by Pharaoh

through Joseph, and the next Pharaoh enslaved them for 210 years. They had done nothing wrong to deserve this:

"[God] said to Abram: Know for certain that your offspring will be strangers in a strange land, and will be enslaved and afflicted for four hundred years. But know with equal certainty that I will judge the nation that enslaved them, and that afterwards they will leave with great substance." [Genesis 15:13-14].

No reason was given. Evidently God thought slavery was necessary. But why, and why for so long? We can speculate after the fact:

- For our protection.
 - Jacob's clan in Israel was an easy target for neighbors. In Egypt, a superpower protected us, albeit to exploit us.
- To build up our numbers in safety.
 - If 210 years is 10 generations and numbers double with each generation, given four children per couple, then the initial number increased a thousand-fold ($2^{10} = 1024$). If numbers triple, given 6 children per couple, then the initial number increased sixty-thousand-fold ($3^{10} = 59,049$). The Talmud says that 3 million people were present at Sinai.
- To build up our identity and community spirit.
 - We were all in the same boat and followed the same customs. Midrash: The Jews deserved redemption from Egypt because they kept their distinct names, dress and language [Lev. R. 32:5 has names and language; Minor Pesikta, Devarim on Ki Tavo 41a has clothing and food]
- To minimize contact with outside world.
 - It may lead to idolatry and other practices later forbidden by Torah.
- To eliminate the possibility of intermarriage.
 - Egyptians wouldn't want to marry slaves and victims of rape would raise Jewish children.
- To create a scenario that allowed God to show the Jews and the whole world who was in charge.
 - He freed the Jews with miracles that make a big impression.
- The gratitude felt upon liberation made it easier for us to accept Torah.
 - First thing God said at Sinai: "I am the Lord your God who took you out of the land of Egypt, the House of Bondage" [Ex. 20:2] A commentator said: The suffering in Egypt was to break our attachment to this world: Suffering makes one more spiritually inclined.
- We acquired building skills in Egypt that served us well as we built our new nation.
- The slave mentality made it easier for us to accept the Torah.
 - But once we accepted Torah, the slave mentality became a burden, so God waited till generation of Exodus died out before letting us into the Land.

-Maharal: Pesach is not the time of true freedom, but rather the time when we changed masters [from Pharaoh to God].

-But one was for the benefit of the master, the other for our benefit.

If God had made slavery less brutal and more tolerable, few would have wanted to leave. Even as it is, Midrash says that 80% refused to go and died in the plague of darkness [Mechilta, Tanchuma, Beshallah 1]. The rest went but grumbled many times about going back.

Judaism and Evolution

What about evolution? Did higher forms of life really develop from lower forms of life through the process of natural selection? Are human beings included in this process? The evidence is pointing that way and many traditional Jewish thinkers are quite prepared to accept it. In the 19th century, Rabbi Israel Lipschutz pointed out the Midrash account I referred to earlier -- that God created many worlds and destroyed them -- and concluded that all fossil evidence is merely the remains of those earlier worlds. In the 1930s, Rabbi Kook, the first Chief Rabbi of what was to become Israel was so enamored of evolution theory that he applied it to the moral and ethical sphere as well, arguing that the values of humanity have been steadily improving. Also, Rabbi Hertz, Chief Rabbi of the British Empire in the first half of the 20th century wrote a chumash, or biblical commentary, that is still being used for Torah services in a large number of American Orthodox synagogues, was also an enthusiastic supporter of evolution. In his chumash, he writes that

“...there is nothing inherently unJewish in the evolutionary conception of the origin and growth of forms of existence from the simplest to the complex, and from the lowest to the highest... [The purpose of] the Creation chapter is to reveal [certain] teachings..., not to serve as a textbook of astronomy, geology, or anthropology. Its object is not to teach scientific facts, but to proclaim highest religious truths respecting God, Man, and the Universe. The -- quote -- “conflict” -- unquote -- between the fundamental realities of Religion and the established facts of Science is seen to be unreal as soon as Religion and Science recognize the true borders of their dominion.” [Pentateuch and Haftorahs, pp. 193-5]

Some Orthodox Jews, such as the Lubavitch Hasidim, feel compelled to reject evolution on the grounds that it contradicts the Genesis account of creation. They hold that, if anything, human beings are

receding in mental ability with every successive generation, because they are further away from the revelation at Sinai. The Talmud says that nothing decided by an earlier generation of Sages can be reversed by a later generation [Avodah Zara' 36a], unless it was an assembly greater in number and wisdom than the earlier one [ibid and Eduyyot 1:4]. They clearly thought this is impossible, because they added: If the earlier generations of Sages were angels, then we are humans; if they were humans, then we are asses [Shabbat 112b]. In plain language, this teaches that people are slowly descending from their original mental heights into imbecility. Evolution, on the other hand, may imply that people are slowly climbing towards ever-higher peaks of knowledge, understanding, and discernment. Of the two, hope and optimism require that we take the second, even if we did not have scientific evidence.

I find the zeal with which some scientists try to prove the Bible wrong somewhat annoying. Here is a funny and trivial example. I once read a book by a scientist who was making fun of the fact that the Bible seems to say that pi is equal to 3. Pi, as you know, is the ratio of the circumference of a circle to its diameter. It has a never-ending decimal expansion beginning with 3.1415. Indeed, the First Book of Kings, Chapter 7, verse 23, says:

And he made a molten sea, ten cubits from brim to brim; it was round all about... and a line of thirty cubits encompassed it all about. [1Kings 7:23]

Well, 30 divided by 10 is 3, and so pi is 3 according to the Bible. I fired off a letter to the author reminding him that the Bible uses rounded numbers, and that if we divide 30 by the value of pi we know to be correct, we find that the molten sea must have been about 9.55 cubits from brim to brim. The Bible would have reported this 9.55 as 10, and sure enough it did. The Bible said "10" and not "10.0", implying that the figure was rounded to the nearest integer.

Here is another way to reconcile scientists and religious traditionalists. The history of the world as expressed by evolution is correct, but at some *specific instant of time* something happened in the mind of an ape -- a spontaneous mutation, a random quantum fluctuation if you will -- and it suddenly acquired consciousness. This was the moment of the "creation of man". Some would call it divine intervention, some random chance, but that is what happened, at a specific instant of

time just as the Torah says, and the ape was put on the road that led to homo sapiens.

Some argue that students must be taught both creationism AND evolution in the classroom, and be allowed to conclude for themselves what makes more sense. By the same logic, schools should also teach both astrology AND astronomy, both alchemy AND chemistry, both magic AND Physics, both numerology AND mathematics, both sorcery AND Medicine, both phrenology AND neurology, both extra-Sensory Perception AND communications, both Flat Earth AND Round Earth. Then students could decide for themselves what they want to accept. This would be an unmitigated disaster in education.

The Jewish calendar: A scientific marvel

I would like now to move on to one of the greatest Jewish scientific achievements: The Jewish calendar. Established in the 4th century and based on centuries of astronomical observations, it is so accurate it never had to be adjusted. All other calendars have required periodic readjustments.

The overriding consideration in building a Jewish calendar is to make sure the holidays are celebrated in their proper seasons. Pessah must be celebrated in the spring, Shavuot in the summer, and Sukkot in the fall. This is because these three pilgrimage festivals are tied to agricultural events: Pessah is *Chag Aviv*, the Festival of Spring; Shavuot is *Chag HaBikkurim*, the Festival of First Fruits; and Sukkot is *Chag Ha-Asif*, the Harvest Festival.

In olden days, the Sanhedrin had to decide when the month and the year would begin, and when the holidays would be celebrated, based on the visual observation of new moons in the Land of Israel. The testimony of witnesses determined the time of the new moon (*molad*), and the practice of observing a “second day” for holidays, just to be sure, was instituted.

However, in the year 358 CE, a permanent Jewish calendar, *Ha-luach ha-ivri*, was put in final form by Hillel II. It is purely mathematical, and requires no new observations. It was derived from centuries of observations and records. It was the last gift of the last Sanhedrin. Indeed, the Romans forced the Sanhedrin to disband at that time, and it never reconvened.

The Jewish calendar is so accurate it never had to be adjusted, unlike other calendars. In the West, first there was the Julian calendar, instituted in 46 BCE, a solar calendar which set the year at 365 days, but added one day to the year every four years (leap years). In time, it had to be adjusted: Eleven days were skipped in 1582, and the Gregorian calendar was instituted. It had the same rules as the Julian, but did not add a day when the year was divisible by 100 but not by 400. For example, 1900 was not a leap year, but 2000 was. It is still in use today, but small corrections are sometimes needed.

The Jewish calendar is lunisolar, that is, it uses both sun and moon. The Torah places some constraints: Certain festivals must take place during certain seasons, or must not fall on certain days of the week. For example, Yom Kippur must not precede or follow Shabbat, as this would mean two consecutive days when one is not allowed to cook or bury the dead, and Hoshana Rabba must not be on Shabbat, so as not to lose certain ceremonies.

Here is an outline on how it operates. The average lunar month is 29 days + 12.734 hours, or 29.53... days; so 12 months is about 354.37 days, about 11 days short of a year. Therefore, we need to provide for about 11 more days per year to preserve the seasons. The calendar adds a 13th month of 30 days, Adar I, **7 times every 19 years**. These “leap” years are Years 3, 6, 8, 11, 14, 17 and 19. A leap year is called a pregnant year in Hebrew (*shanah meuberet*). In leap years, the “regular” Adar, meaning the one with 29 days, is the second one, Adar II. So Purim is always in Adar II.

This is not enough: More adjustments are needed, and are provided by changing the length of some months. The months normally alternate between 29 and 30 days. The full months, those of 30 days (*maleh*) are Nissan, Sivan, Av, Tishri, Kislev, and Shevat. The deficient months, those of 29 days (*chaser*), are Iyyar, Tammuz, Elul,

Cheshvan, Tevet, and Adar. The adjustments are made by changing the length of Kislev and Cheshvan. The years alternate between:

- Full (*shlemah*), where Kislev and Cheshvan both have 30 days,
- Regular (*k'sidrah*), where Kislev has 30 days and Cheshvan has 29 days, and
- Deficient (*chaserah*), where Kislev and Cheshvan both have 29 days.

In full months, Rosh Hodesh is both the 30th day of the previous month and the first day of the next month, because the new moon straddles both days.

Because of these small adjustments, a full cycle repeats exactly, not every 19 years, but every 689,472 years!

Now, Rosh Hashana is the only holiday to fall on first day of a month. Before the permanent calendar, to be sure of the time and so as not to rely on last-minute witnesses for such a major holiday, Jews always celebrated for two days, even in Israel. This also made sure that the Shofar can be blown even if one of the two days is Shabbat. For this last reason, Rosh Hashanah is still celebrated for two days in Israel.

The basic Jewish unit of time is the *helek*, or $1/18^{\text{th}}$ of a minute, which is about 3 1/3 seconds. There are therefore 1,080 *halakim* in one hour. The Jewish week goes from Sunday to Saturday; in Hebrew, from Yom Rishon, or Day 1, to Shabbat, or Day 7. The Jewish day ends when three stars are seen in the sky. The first day of the Jewish calendar was 1 Tishri 1, corresponding to Monday 7 October 3761 BCE, the traditional day of the creation of man. The creation of the world was six days earlier, on 25 Elul 1 [Pesikta d'Rav Kahana 23:1]. Note that Jews designate secular years by BCE (before the common era) and CE, not BC and AD.

Is the Jewish Calendar the final word for calculating when Jewish holidays will fall? Maybe and maybe not. We now know that variations in the tides cause the Earth's rotation to slow down, making the average lunar month 0.6 seconds longer than assumed by Hillel II. This was too small a change to be noticed by the ancients. If this slowing persists, which is not certain, then 10,000 years from now Pessah will drift dangerously close to summertime and a correction to

the calendar will be needed. But, in the meantime, the Jewish calendar remains an unparalleled marvel of scientific accuracy for the dark times in which it was developed.

Judaism in Space

Let us now turn to another Jewish matter with scientific overtones. As humanity goes into space, how do you practice Judaism there? Three questions:

- What to do on a spaceship, where there would be no day, no night, no seasons, no sun, no moon, no gravity, no Israel?
- What to do on a planet, where the days, years, and seasons would be different?
- How would aliens from outer space relate to Judaism?

It is early for definitive answers, but some responsa on the matter are available. Only after lots of observant Jews go into space will minhagim and definitive halacha arise.

First note that there have been 14 Jewish astronauts so far:

- First: Boris Volynov, USSR, flew Soyuz in 1969 and 1976
- Second: Judy Resnick, USA, flew Shuttle in 1984 and 1986
- Third: Jeffrey Hoffman, USA, flew Shuttle 5 times, 1985-1996
- Also flew 5 times: Marsha Ivins, USA, 1990-2001; John Grunsfeld, USA, 1995-2009
- Others are:
 - Israeli Ilan Ramon, 2003
 - Americans Ellen Baker, Jerome Apt, David Wolf, Martin Fettman, Scott Horowitz, Mark Polansky, Garrett Reisman, and Gregory B. Burchett.

Let us pause now for some levity. Space jokes:

- The first rabbi in space returns exhausted: "We went around the earth every 90 minutes. For us, a day was 90 minutes -- Shacharit, mincha, maariv, shacharit, mincha, maariv -- no time for anything else!"
- Why were the nine little green men so happy to see the first Jewish astronaut land on Mars? Answer: He made a minyan!
- A man returns from the first bar mitzvah on Pluto, disappointed: "The band was very good, the food was out of this world, but there was no atmosphere."
- At beginning of Torah service, we say:
Gadlu l'Hashem iti! [Ps. 34:4]

Wrong translation: Declare the greatness of God with me!

Correct translation: Declare the greatness of God, E.T.!

It is an invitation to extraterrestrials to join us in praising God!

-Talmudic twist on whether Jews may take time from Torah study for secular subjects:

Ben Damah, the son of Rabbi Ishmael's sister, once asked Rabbi Ishmael, "May one such as myself, who have studied the whole of the Torah, learn Greek philosophy [chochmat yevanit]?"

He [Rabbi Ishmael] then read to him the following verse, "This Book of the Torah shall not depart from your mouth; but you shall meditate on it day and night" [Joshua 1:8]

Go then, and find a time that is neither day nor night, and then you may learn Greek philosophy. [Menachot 99b]

Was he telling him to go off on a spaceship, to the middle of nowhere in space, where there is neither day nor night?

Now, let us ask: Is space exploration religiously mandated? The Torah says:

God blessed them and said to them, "Be fruitful and multiply; fill the earth and subdue it. Rule over the fish in the sea and the birds in the sky and over every living creature that moves on the ground." [Genesis 1:28]

Some interpret "the earth" as meaning "the entire universe".

At any rate, as we mentioned, humanity may have to go into space out of necessity. The Sun is an ordinary star, so is expected to die in 5 billion years. It does not have enough mass to explode as a nova, so it will turn its hydrogen into helium, become a red giant, expand to engulf the earth, then contract and heat up. The Talmud says that when that happens, God will grant us wings to escape the earth:

And should you ask, in those years during which the Almighty will renew his world [after destroying it], as it is written, 'And the Lord alone shall be exalted in that day' [Isaiah 2:11], what will the righteous do? The Lord will make them wings like eagles, and they will fly above the water, as it is written, 'Therefore we will not fear when the earth will be removed and the mountains be carried into the midst of the sea.' [Ps. 44:3.] And should you imagine that they will suffer pain, Scripture says, 'But those who wait upon the Lord shall renew their strength; they shall soar on wings like eagles; they shall run and not grow weary; and they shall walk and not faint.' [Isa. 40:31] [Sanhedrin 92b]

The Zohar goes one step further:

The Holy One, blessed be He, will provide them with wings as of eagles, enabling them to fly across the whole universe. [Zohar, Bereshit 1, page 12b]

As we mentioned, the Midrash says that God created other worlds before ours, and destroyed them because He did not like them:

Rabbi Abbahu said: Hence we learn that the Holy One, blessed be He, went on creating worlds and destroying them until He created [heaven and earth], and then He said: "These please Me; those did not please Me."

[Genesis Rabbah 9:2]

This implies there will be refugees, like Noah and his family, only this time they will go into space. Finally, as we discussed earlier, science predicts the Heat Death of the universe, when entropy increases until all particles mill about in random motion, in more than 100 billion years. Science has no clue on periods before Big Bang or after the Heat Death.

Now, on a practical level, how does one observe time-bound mitzvot where the seasons are different? Actually, this problem dates from the 18th century, when Jews started moving north, where daytime and nighttime can last for days or weeks. The Talmud is our guide:

Rav Huna says, if a man is wandering in the desert and he does not know when Shabbat is, he should count six days [as weekdays] and keep one day as Shabbat.[Shabbat 69b]

Rava says, "...every day he may do whatever he needs in order to survive, even on Shabbat."

The law is that a wanderer who lost track of time keeps six "weekdays" followed by one "Shabbat", but he may not do anything forbidden on Shabbat, on any day, except to survive. He must act out of concern that the real Shabbat may be on ANY day. [Shulchan Arukh, Orakh Hayyim 344]. Note that the same logic was originally used to observe two holy days in the Diaspora vs one in Israel.

When day or night lasts for six months, as happens near the poles, there are many opinions:

-**Rabbi Jacob Emden** (18th century) says:

-Count 6 days of 24 hours and keep the 7th as Shabbat.

-**The Tiferet Yisrael** [Mishnayot Yachin U'Boaz - Brachot: End Chap 1,(1782-1860)] says:

-Use times for prayers of place from where you came.

-**The Ben Ish Chai** [Teshuvot Rav Pa'alim - Sod Yesharim 2:4, Sephardic, 1832-1909] says:

-Consider 6am to be sunrise and 6pm sunset.

-**The Moadim U'Zmanim** [Chalek Bais (2) Siman 155 in the glosses] says:

-In summer, when the sun does not set, consider that a day begins and ends when sun is at its lowest point in the sky, usually around midnight.

-In winter, when sun does not rise, consider that a day begins when sun is closest to the horizon, usually around noon.

In space, there are two opinions:

-Rabbi Ben Tzion Firrer [5730 issue of Noam] says that mitzvot are only applicable on earth, because the Torah says:

These are the statutes and judgments, which you shall take care to do, in the land [ba-aretz], which the Lord God of your fathers gives you to possess all the days that you live upon the earth [ha-adamah]. [Deuteronomy 12:1]

Note, however, that it does not say: Don't do mitzvot outside the Land or the Earth.

-Rabbi Menahem Kasher [5730 issue of Noam] says that mitzvot are incumbent in every environment. The themes of the festivals, of Shabbat remembering creation, of the daily prayers, are always relevant. So apply same rules on the moon and in space as for the North Pole.

-The second opinion is most likely to prevail. Possible details:

-When orbiting earth, use only time measured at place you left from

-Some say: Keep Shabbat anytime it is Shabbat anywhere on Earth.

-When going far from the earth, use the clock on the spaceship wall, synchronized at liftoff with time and place you left earth, and follow sunrise/sunset times and Jewish calendar for that place after that.

-Observance can't ever truly "be" simultaneous with place of origin because of relativistic twin effect (one twin stays on earth and the other travels in space, and when the traveler comes back he is younger than his twin – he has actually experienced less time).

-On Earth, pray towards Jerusalem. So, in space, pray towards earth.

-May do essential ship maintenance on Shabbat and holidays, since lives are at stake (pikuach nefesh)

-When on a planet in space, pro-rate length of day or year:

-Rabbi Azriel Rosenfeld: On Mars, a "day" is 24 hours and 39 minutes in earth time and a "year" is 687 days in earth time, so modify observance calendar accordingly (pro-rate?).

-Also, when on the moon, one need not bless the full moon (Kiddush Levana, done at night outside between Rosh Hodesh and time of full moon).

-Lubavitcher Rebbe concurred.

How does absence of gravity affect halacha? For example, the Torah mandates building a parapet around a roof for protection:

-When you build a new house, make a parapet around your roof so that you may not bring the guilt of bloodshed on your house if someone falls from the roof. [Deuteronomy 22:8]

But what if there is no gravity, and therefore no danger to life? Do you still have to observe the mitzvah? Can we say: This is one commandment stated along with the reason for it, so when that reason does not apply, neither does the commandment?

Now let us ask: Can one keep kosher with recycled food? In science-fiction, the *Star Trek* food replicator recycles everything on the ship and builds food from individual molecules. If they build pork chops, may Jews eat them?

-Halacha would say yes. Pork is the flesh of pigs and may not be eaten. But the replicator product is not the flesh of pigs. It is assembled from individual molecules, so it can be eaten. After all, when you bite into a fresh apple, you are eating some molecules that once belonged to a pig 100 years ago, and it's OK. Nature recycles everything.

-But what if the Torah prohibition is for health reasons? What if eating two strips of bacon a day will lower your IQ by 1 point a year, and we are unable to detect that yet? Then the replicator pork chop and the flesh of the dead pig will have the same bad effect on you, since they have the exact same chemical composition. The apple above does have enough bad molecules in it to hurt you, but the replicated pork chop does.

-But the halacha of food is not chemically based:

-If water comes into contact with treif, it must not be drunk even if boiled, evaporated and condensed in a new pot.

-So eat the replicated pork chops, and if later evidence shows they hurt you, stop eating them. Some food is known to be both kosher and poisonous: Don't eat it.

Do all food restrictions, including on Pessah, disappear if replicators are only source of food?

What if we encounter intelligent life outside the earth? The Talmud says that the world was created for man's sake:

The Holy One, blessed be He, [said]: My daughter, I have created 12 constellations in the sky, and for each constellation I have created 30 hosts, and for each host I have created 30 legions, and for each legion I have created 30 cohorts, and for each cohort I have created 30 maniples, and for each maniple I have created 30 camps, and to each camp I have attached 365,000s of myriads of stars [1 myriad=10,000], corresponding to the days of the solar year, and all of them I have created only for your sake. [Berachot 32b]

(Note, in passing, that the Talmudic number of stars comes to 1.06434×10^{18} . The best scientific estimate today is 10^{23} , but that follows from assumptions that may change (before Dec 2010 it was 10^{22})).

First, alien beings are consistent with Judaism:

-Song of Deborah:

Curse Meroz, said the messenger of the Lord, curse bitterly its inhabitants. [Judges 5:23].

- Talmud: Some say Meroz is a person or a city; others that it's a star or planet [Moed Katan 16a], based on
They fought from heaven; the very stars in their courses
fought against Sisera. [Joshua 5:20]
- So Sages imply there may be extraterrestrial life.
- In *Ashrei*, we say
Your kingdom is a kingdom of all worlds. [Psalms 145:13]
- Hasdai Crescas [14th century] sees proof of extraterrestrial life in:
The heavens declare the glory of God. [Psalm 19:2]
His *Ohr Hashem* has a chapter where he reconciles extraterrestrial life with Judaism. He cites Talmud:
God flies through 18,000 worlds. [Avoda Zara 3b]
Surely God goes there because they have inhabitants who need Him.
- Rabbi Yosef Albo ("Ikkarim", 15th century): Since the universe was created for the sake of humanity, no other creature can exist possessing free will.
- Sefer Habrit [Rabbi Pinchas Eliyahu of Vilna]: Aliens exist, and may even be intelligent, but do not have free will.
- The Lubavitcher Rebbe: One who declares that there is no life besides on earth is limiting the Creator's abilities.
- Tikunei Zohar (kabbalistic work): Every tzaddik (righteous person) will rule over his own planet.

Second, would aliens be allowed to convert to Judaism? What if their anatomy is different? What do they circumcize? If a Martian has no arms, how would he wear tefillin? (Halacha: He doesn't. Just as a Jew missing arms is exempt from wearing tefillin of the arm. You only do what you can.) But, if we accept R. Albo's view, aliens have no free will and so cannot convert.

What do we conclude? Judaism has survived such upheavals as the end of Temple worship and the Exile from the Land, and has adapted, and thrived. So it is safe to say that it will adapt to space travel and life outside the earth as well, and thrive.

Now let us switch to the relationship between Judaism and Soft or Pseudo-Science, beginning with...

Bible Codes

You can extract a lot from the Torah if you put your mind to it. Our Sages tell us that there are four levels of understanding of the Torah, each one deeper than the previous one: *Pshat*, *remez*, *drash*, and

sod. As you move from one level to the next, new meanings come to light. As we mentioned earlier, even if you don't believe a story literally, you can always understand it as a parable that provides valuable teachings.

Today, in the age of the computer, people are expanding that concept to look for hidden codes in the Bible. Some say that if the letters in the Torah are rearranged in certain ways, you can read a secret message, or an account of events that happened after the Torah was revealed, or will happen in the future. They can also prove that the probability of this occurring by chance is very low. Is this significant? Are there hidden codes in the Bible?

The notion of Bible codes (Hatzofen ha-Tanachi) has a long history. It was noted long ago that every 50th letter of the Book of Genesis starting with the first tav spells "torah". Same for the Book of Exodus. Computers have made this search much easier. A 1994 paper by Witztum, Rips and Rosenberg, "Equidistant Letter Sequences in the Book of Genesis", in the journal *Statistical Science*, presented statistical evidence that the names of famous rabbis, as well as their birth and death dates, was encoded in Genesis, long before those rabbis lived. Publicized by Michael Drosnin, in "The Bible Code" (pub. 1997). Other scholars rejected the claim, on the grounds that noise can frequently appear to be meaningful, and that similar patterns can be found in other books.

Coming from the world of theoretical physics, rather than the world of statistics, I don't understand the fuss about Bible codes. Here's why.

Consider the Torah to be a long string of characters. Number them 1, 2, 3, 4, etc. Suppose you got a clear message by taking every other character (say, characters 2, 4, 6, 8, etc.). Then people would say, "There you go, clear as day. You have to be in denial not to recognize that this is a hidden message from God." The formula for that message would be simply $2 \cdot n$. It requires only three keystrokes to describe. Its simplicity would argue in favor of its truth.

Fair enough. But suppose you got a message by using characters 1, 4, 9, 16, 25, etc. It's a little more complicated, but you would eventually notice that the pattern is to take the squares of the

numbers. The formula is n^2 . It still requires only three keystrokes, and so people can still argue that it's simple enough to not be mere coincidence.

Fair enough. But now suppose you got a message with a more complicated formula, say $2*n + n^2$ (that is, take characters 3, 8, 15, 24, 35, 48, etc.). It takes seven keystrokes to describe it. Should that be considered a fluke or an intended message? Harder to say. The more complicated the formula is (that is, the more keystrokes are needed to describe it), the more doubtful it becomes that a message was intended.

Now here comes the shocker. Suppose you wrote any message you wanted in advance, then went to the Torah to find out which character sequence gave you that message. One can prove mathematically that you are *guaranteed* to find a formula that will give you that sequence. It's a polynomial in n , to use the jargon. Not only that, but you are guaranteed to find an infinite number of such formulas. One of these will be the simplest one: It will require the fewest keystrokes to describe. Once you found that formula, how would you know if it is simple *enough* that you can conclude the "message" was intended? That is a subjective question, not an objective one, and there can be no definitive answer.

Here is one conclusion. Yes, there is a message in the Torah. The formula is: n . Take characters 1, 2, 3, 4, etc. In other words, just read the Torah. That is the simplest formula of all. Only one keystroke is required to describe it. There is your message. And it is not hidden.

So the simple truth is that, given ANY sequence of numbers, there is ALWAYS a formula that ties them together and enables you to predict the next one, and the next one, and the next one. In fact, there is an infinite number of such formulas, and they predict different "next numbers".

If you are given one more number than originally given, you can eliminate many such formulas, but will still be left with an infinite number of them. In that sense, NOTHING is truly "random". You can "make sense" out of anything.

I often wondered if this simple mathematical result does not apply to the world at large, with startling conclusions. All the facts that the human adventure has revealed to us are, after all, only a finite collection. A very large finite collection, but a finite collection nevertheless. We try to tie all these facts together into a theory of the world. We do this because we don't like randomness. We like to see patterns, and behind the patterns, we like to see purpose and design. We are guaranteed to succeed (a comforting thought!), but only too well: There is an infinite number of such patterns. When new facts come to light, many of these theories fall by the wayside, but that still leaves an infinite number of them.

This means good news and bad news. The good news is that there is always more than one way of making sense of the world. In fact, there is an infinite number of ways. This should teach us tolerance. The other guy's understanding is not necessarily wrong, it may be just different, and just as valid. The bad news is that we will NEVER be able to reach THE “real” theory of the universe (except by a lucky guess, and even then we'll never know we are right). This is because we can only be in possession of a finite number of facts. In fact, we can't even say that we are getting closer, since a finite number of facts always implies an infinite number of “theories” that tie the facts together. So the quest for knowledge continues, in an endless process.

But there is more. Can one theory be “better” than another, even if both fit the facts? Of all the theories, one of them will be the simplest, meaning that it will require the fewest keystrokes to describe. For no reason other than elegance, scientists prefer to use, as a working hypothesis, that “simplest” theory. This is known as the principle of Occam's razor: Always go for the simplest explanation that fits the facts, but remember that there are other explanations, and that one of these others may be the right one.

Could it be that Judaism has the “simplest” philosophy of life, and that even though the others in existence are not “wrong”, they are not as “simple”, as minimalistic? Jews say that God is One. That's the simplest “theory”. Certainly not the first one that comes to mind, given the baffling diversity of the human experience, but the simplest

nevertheless. It forces us to assume that everything is connected to everything else, and that always leads to progress in understanding.

An even more sobering thought is that there **is** no right explanation! The human experience is an ever-increasing, but still finite, collection of facts. These facts, as we saw, can fit into any one of an infinite number of theories. But we are free agents and have much leeway in creating facts. Could it be that every time we witness or create a new fact, we are not merely making history, but also modifying the very fabric of the universe, creating the very laws that rule our universe, in partnership with the Almighty?

The notion of Bible codes leads us straight to a related and ancient field: Gematria, or Jewish numerology.

Gematria

Gematria consists of assigning a number to each Hebrew letter. By tradition, the first letter, *aleph*, is 1, *bet* is 2, *gimel* is 3, *daleth* is 4, and so forth, up to 10. Then the letters, in alphabetical order, are assigned the numbers 20, 30, 40, etc. up to 100. Then 200, 300, and finally the last letter, *tav*, is 400. Some include the final form of the letters, others don't. For those, the final *kaf* is 500, the next final letter is 600, up to the final *tzadi*, which is worth 900.

For example, the word “*chai*”, *chet-yod*, meaning “alive” is worth 18, because *chet* is worth 8 and *yod* is worth 10. Because 18 is associated with life, the custom arose to make charitable contributions in multiples of 18. The name of God, the Tetragrammaton, is worth 26. “*Shalom*” is worth 376. That's $300+30+6+40$.

When two words or phrases have the same gematria, meaning that they are worth the same number, it is believed that they have deep connections. Commentators then speculate on what these connections might be.

Also, two gematriot that differ by 1 are considered to be the same, because they are close enough. 19th century Rabbi Zvi Elimelech Shapiro of Dynov, known as Bnei Yissaschar, writes:

From where do we know that gematriot that differ by one are considered equal? We learn this from Jacob saying that Ephraim and Menashe (gematria of 726) are equivalent in his eyes to Reuben and Simon (gematria of 725). And when did Jacob say that? [In the Torah,] when he reversed his right and left hands. [Gen. 48:12–20]

Gematria is widely used in Jewish mysticism, in particular.

What do Jewish commentators say about gematria? They are either in favor of it or neutral to it, not opposed to it. But they laid down two rules about gematria:

-First, you cannot extract Jewish law, or halacha, from it. No rabbinic rulings must be based on it. For example, one cannot say: “The name of this product has the same gematria as the word “*kosher*”, therefore the product is kosher.”

-Second, as the Ramban, or Nachmanides, emphasized, gematria cannot be used to foretell the future. It is only a mnemonic device.

What objections can be raised against the use of gematria? First, a method for extracting meaning from Torah must be applied consistently or not at all. You can't apply it when it suggests associations that make you feel good, and decline to apply it when it suggests unpalatable associations.

For example, as we saw, the number 376 is associated with *shalom* – peace. But it is also associated with Esau, Jacob's evil twin brother. Are the two connected? It would be a stretch. Yet some commentators suggest a connection. The Baal HaTurim, the 14th century Spanish commentator, says:

If not for his name, which means peace, Esau would have destroyed the world. [Baal HaTurim, Bereshit 25:25]

and

Always be first to greet a person with “Shalom”, even if he is a gentile [like Esau]. [Baal Ha Turim, Bamidbar 6:26]

Another says:

-There is no peace for Israel [that is, Jacob] if there is no peace for Esau. [Leibowitz, Seven Years of Discussions of the Weekly Parasha, p. 110]

These are nice homiletics, but hardly compelling.

A good counterexample is the number 86. It is associated with *Elokim*, the first name of God mentioned in the Torah. But it is also associated with the word *Ha-teva*, which means nature. Do we conclude that God is the same as nature? That would be pantheism, and is specifically rejected by Jewish thought.

Another counterexample is the number 210. Again, in our parsha Jacob tells his sons “Go down to Egypt” [Genesis 42:2]. “Go down” is “*Redu*”, and “*Redu*” is 210. The Israelites stayed in Egypt for 210 years, and gematria concludes that this was foretold in the word *Redu*. But earlier, God told Abraham ‘Get yourself out...from your country...to a land that I will show you...’ [Genesis 12:1] ‘Get yourself out’ is ‘*lech lecha*’. ‘*Lech*’ is 50, that is 30+20, and ‘*lech lecha*’ is 100. If the final *chaf* counts as 500, then it's 530+530, or 1060. Did the Jews spend 50 years in Israel? 100? 530? 1060? None of the above. So why interpret the gematria that way in one case and not the other?

Or take the lifespan of the patriarchs. It was noted that the factors always add up to 17, which is the gematria for ‘*tov*’, or ‘good’. Indeed, Abraham lived to 175, or $5 \times 5 \times 7$, and note that $5 + 5 + 7$ is 17. Isaac lived to 180, or $6 \times 6 \times 5$, and note that $6 + 6 + 5$ is 17. Jacob lived to 147, or $7 \times 7 \times 3$, and note that $7 + 7 + 3$ is 17. But a factorization is done with prime numbers. 6 is not a prime number; it is 2×3 . If 6 is replaced by 2×3 , that gematria observation becomes invalid.

Or consider the principle that two gematriot that differ by 1 are considered the same. If so, then if they differ by 2, they are also the same, because each is the same as the number in between. And if they differ by 3 they are also the same, and so on. So they are all alike, and anything can be interpreted to mean anything.

Another problem is that many practitioners of gematria confuse “finding a deep connection”, which is hard, with “putting the two words in the same sentence”, which is easy. One can always come up with a connection by thinking hard enough. But is that connection compelling? Are we manufacturing “teachings” out of thin air -- foreordained teachings that we already know and resonate to, and that do not require gematria “validation” to begin with?

We can conclude that gematria is a practice whereby, if you know the answer in advance, you can look around until you see numbers that give it to you. If you don't know the answer in advance, it is useless. That's essentially the conclusion reached by Nachmanides, mentioned above: Gematria can be a useful mnemonic device, but cannot be used to predict the future.

Let us now veer clearly into pseudo-science, and examine the Jewish view of the supernatural.

Judaism and the Supernatural

In the Torah, miracles and magic abound. Consider this excerpt from the Book of Exodus:

-Aaron cast his staff before Pharaoh... and it became a serpent. Pharaoh's [magicians] did likewise... But Aaron's staff swallowed their staffs... [Ex. 7:10-12]

-Aaron... struck the water that was in the Nile before the eyes of Pharaoh... and [it] turned to blood. And the necromancers of Egypt did likewise with their secret rites... [Ex. 7:20-22]

-And Aaron stretched forth his hand over the waters of Egypt... and the frogs came up and covered the land of Egypt. And the necromancers did likewise... [Ex. 8:2-3]

-Aaron stretched forth his hand with his staff and struck the dust of the earth... and the lice were upon man and beast. And the necromancers [could not do] likewise... So [they] said to Pharaoh, "It is the finger of God." [Ex. 8:13-15]

Supernatural events or beliefs are those that do not conform to our current understanding of the laws of nature. Our Sources are full of apparently supernatural events caused by God and man. Many people strongly believe in the supernatural.

What does the Torah say about it? The Torah seems to resolutely forbid engaging in supernatural activities:

-There shall not be found among you anyone who... uses divination, or a soothsayer, or an enchanter, or a witch, or a charmer, or a medium, or a wizard, or a necromancer. For those who do these things are an abomination to the Lord, and because of these abominations the Lord your God drives them out from before you... For these nations... listened

to soothsayers, and to diviners; but as for you, the Lord your God has not allowed you so to do. [Deut. 18:10-12; also Lev. 19:26]
It even goes so far as saying:
-You shall not suffer a witch to live. [Ex. 22:17]

Yet some of these practices are tolerated, sometimes even viewed positively. The Talmud even accepts those that clearly have no tie to idolatry. Let's review them.

First, **necromancy**. It means communicating with the dead, especially to predict the future. There is an instance of that in the Bible, the episode of the Witch of Endor:

And [the prophet] Samuel was dead. [King] Saul had expelled the mediums and the wizards out of the land. [Yet]... when Saul saw the camp of the Philistines, he was afraid ... and inquired of the Lord, [but] the Lord did not answer him...

So Saul [went to the witch of] Endor... and said, "Bring me up Samuel..." [She did.] Samuel [came up and] said to Saul, "Why have you disturbed me...?"

And Saul answered, "I am greatly distressed, for the Philistines make war against me, and God has departed from me..."

Then Samuel said... "Tomorrow you and your sons shall be with me, and the Lord shall deliver the camp of Israel into the hand of the Philistines."

[1Sam 28:3-19]

So, in distress, Saul forgets his own principles and seeks a necromancer!

Now, foretelling the future is not possible given our current understanding of physics. The uncertainty principle in quantum mechanics precludes such predictions. Besides, commandments are meaningless if people don't have free will. Nevertheless, this belief is not totally denied in Judaism. The Code of Jewish Law says:

It is permitted to make a dying person swear to return after his death in order to convey some information he will be asked. And some permit an attempt to do this even after the person has died provided that he does not conjure the actual corpse but the ghost of the dead man. [Shulchan Aruch YD 179:14]

Note that there is no promise the attempt will be successful, though!

Second, there is the matter of the **Evil Eye**, or *Ayin hara'* in Hebrew. Some rabbis in the Talmud warned that your good fortune will cause envy, and this envy will cause harm to fall on you. So they enjoined us not to advertise our good fortune. [Bava Metzia 107b, Pesachim 50b]

However, some said this concern applies to gentiles but not to Jews. [Berachot 55b, 20a] To wit, when a woman tried to cast a spell on Rabbi Hanina, he said:

Try as you will, you will not succeed, for it is written [in the Torah]: “There is none else beside [God]. [Deut. 4:35]” [Hullin 76b]

A common Jewish expression is *Kenahora*, a corruption of “*Ken ayin hara*”, meaning “Let there be no evil eye”. Amulets abound to ward off the evil eye, such as blue pearls, or the Hand of Fatima.

Third, **Extra-Sensory Perception**, or ESP. The prophets of old were believed to enjoy special powers such as telepathy, clairvoyance, and senses beyond the senses. However, the age of prophecy ended with Malachi 2,500 years ago. Some modern experiments have claimed a scientific basis for ESP, but no solid evidence was found. It is theoretically possible that unknown powers of the mind exist, but without controlled reproducibility, nothing can be said about them.

Next is **faith healing**. Healing diseases by religious faith was practiced in the days of the Talmud [Berachot 5b]. The Baal Shem Tov, the 18th-century founder of Hasidism, used it by laying his hands on the sick while pronouncing the secret Name of God. In 1916, Rabbi Alfred G. Moses wrote an influential book called “*Jewish Science: Divine Healing in Judaism*”, which was followed in 1922 by the founding of the Society of Jewish Science by Rabbi Morris Lichtenstein. Bernard Malamud’s story *The Silver Crown* popularized faith healing.

The power of the mind over the body is real. It is verified every day when new drugs are tested. It is called the placebo effect. One group of patients gets nothing, another group gets the experimental drug, and a third group gets a placebo, which is just a sugar pill with no drugs in it. It is found that many patients who get the placebo show an improvement in their condition, because they believed they got the new drug. The new drug cannot be certified as effective unless many more patients get better with it than patients who get the placebo.

In general, Judaism recognizes the healing power of spiritual faith, but disapproves of cults that deny reality.

Next, let us tackle **demons**. Demons, or *shedim* in Hebrew, are supernatural malevolent beings. The Talmud accepts their existence. Rationalistic rabbis, such as Maimonides, Saadia Gaon, or Ibn Ezra, deny their existence. They are now considered only *middot hasidut*, or “customs of the pious”, and belief in them is optional [Rav David Bar-Hayim].

Apparently Abraham was familiar with supernatural practices. The Torah says:

Abraham gave all that he had to Isaac. But to the sons of his concubines, Abraham gave gifts while he was still living. [Gen. 25:5-6]

The Talmud elaborates:

What gifts? Rabbi Jeremiah bar Abba said: He gave them [the secrets of] “*tumah*” [that is, impure powers, such as the knowledge of sorcery, demons, etc.] [Sanhedrin 91a]

Next is **superstition**. Maimonides hated all superstition with a passion, but made allowances to set people's minds at ease. He wrote:

A person bitten by a scorpion or serpent may whisper a charm over the wound even on the Sabbath, in order to settle his mind and to strengthen his heart. The thing is of no avail whatsoever, but, since he is in danger, he is permitted to do it, so he won't feel troubled. Those who whisper upon a wound a charm, consisting of verses from the Torah, or who read such verses over a child to save it from fear, or who place beside an infant a Torah scroll or tefillin to make him sleep, are not only guilty of superstition, but are amongst those who deny the Torah. They treat the words of the Torah as mere bodily medicine, whereas they are spiritual medicine. [Rambam, On Idolatry, 2:11-12].

In another example, the Talmud says that if a woman's first two husbands die, she must not marry again because it would bring bad luck to the third husband [Yevamot 64b]. However, Maimonides adds that if the woman has married again anyway, the marriage is valid and her third husband need not divorce her. [Rambam, On Prohibited Marriage, 21:30]

He also stressed that a mezuzah must contain only the Shema, which the Torah says must be inscribed “on the doorposts of your house” [Deuteronomy 6:9]:

Those who write upon the mezuzah the names of angels have no share in the World to Come. Not only do these fools fail to carry out a divine precept, but they treat the religious duty of proclaiming the Unity of God

and acknowledging the love and service due to him, as though it provided them with an amulet for their own profit. [Rambam, On Tefillin, 5:4]

Ironically, his own synagogue in Egypt, the 10th-century Maimonides synagogue and yeshiva:

כניס ابن מيمون , *Bet Kneset ha-Rambam* , בית כנסת הרמב"ם , has traditionally been considered to have miraculous healing powers! Ailing local Jews slept in an underground room, hoping to dream of Maimonides and get better. I grew up in Cairo, Egypt, and although I am not aware that anyone in my family ever went to Maimonides' synagogue to get cured, I have seen many superstitious customs, such as placing lumps of sugar in the Ark among the Torah scrolls, then putting the sugar in the sick person's tea, hoping it will effect a miraculous cure.

A joint study by the University of Texas and Northwestern University concluded that people have a visceral need for order, even if that order is imaginary. So those who feel a lack of control try to impose one through superstitious beliefs. Full disclosure: I am a theoretical physicist and I have no faith in superstition. However, I am always in favor of testing things out under controlled conditions. So far these tests have revealed nothing real in the supernatural.

Next we tackle the most persistent of all supernatural beliefs: Astrology.

Astrology

When the Torah prohibits many supernatural practices:

There shall not be among you anyone who makes his son or his daughter pass through the fire, or who uses divination, or a soothsayer, or an enchanter, or a witch, or a charmer, or a medium, or a wizard, or a necromancer. For all who do these things are an abomination to the Lord.

[Deut. 18:10-12]

is astrology included? Astrology, or, in Hebrew, *hokmat ha-mazalot*, meaning "the wisdom of the constellations", is not specifically mentioned in the Torah, but the above quote has been used to forbid the practice. Let us review the opinions on astrology expressed in our Sources.

First, the prophets scoffed at astrologers. The prophet Isaiah said mockingly:

Let now the astrologers, the star gazers... stand up and save you from these things that shall come upon you. Behold, they shall be as stubble; the fire shall burn them; they shall not save themselves from the power of the flame... none of them shall save you. [Is. 47:13-14]

The prophet Jeremiah said that, unlike other nations, Israel must not be afraid of what astrologers say:

Thus says the Lord... Do not be dismayed at the signs of heaven, for [only the other] nations are dismayed at them. [Jer. 10:2]

The Midrash adds:

In the days of Jeremiah the Israelites wished to entertain this belief [in astrology], but the Holy One, blessed be He, would not permit them... Your ancestor Abraham [also] wished to entertain this belief long ago, but [God] would not permit him. [Gen. R. 44:12]

The famous Talmudic rabbi Shmuel, who lived in the 3rd century, studied astrology and concluded it was not consistent with Torah:

The Torah is not to be found among astrologers whose work is to gaze at the heavens... The Torah itself says:

The Torah is not in heaven – *lo bashamayim hi*. [Deuteronomy 30:12]
[Deut. R. 8:6]

Yet a large number of Talmudic rabbis believed that stars influence our destinies, although they were divided on the details. For example, does the power of the stars extend to Israel? Rabbi Akiva, Rabbi Yochanan, Mar Shmuel, and Rav Nahman ben Yitzhaq believed it did not:

There is no constellation (*maza*) for Israel. [Yochanan in Shabbat 156a; Shmuel in Shabbat 156b; Sukkah 29a].

But Rabbi Hanina ben Hama believed it did:

The stars make one wise, the stars make one rich, and there are stars for Israel. [Shabbat 156a]

The rabbis were also divided as to whether one could change what the stars decree by being virtuous. For example, Rava said one could not:

Life, children and sustenance do not depend on merit, but on the stars. [Moed Katan 28a]

But Rabbi Akiva believed one could, witness this story:

Rabbi Akiva had a daughter. Astrologers told him: On the day she enters the bridal chamber a snake will bite her and she will die. He was very worried about this. On [her wedding] day she took a brooch and stuck it into the wall. By chance it penetrated the eye of a snake. The following morning, when she took it out, the snake came trailing after it. Her father asked her: "What did you do?" She replied, "A poor man came to our door in the evening, and everybody was busy at the banquet, and there was none to attend to him. So I took the portion that was given to me and gave it to him." He said: "You have done a good deed." He went out and lectured [based on the Book of Proverbs:]: "Righteousness delivers from death." [Prov. 10:2, 11:4] [Shabbat 156b]

Shmuel also said one could, and gave rules of health and agriculture based on astrology. [Shabbat 129b; Eruvin 56a].

Many Talmudic rabbis believed everyone has a "guiding star":

- Every man has a celestial body (*mazal*) as his patron since his conception. [Shabbat 53b; Bava Kamma 2b]
- It perceives things unknown to him. [Meg. 3a; Sanh. 94a]
- Two people born under the same star have a bodily and spiritual kinship. [Ned. 39b; Bava Metzia 30b]

The Midrash adds that this does not apply only to human beings, but:

There is not a blade of grass that does not have its constellation in the heavens to strike it and say to it: "Grow!" Rabbi Ḥanina ben Papa and Rabbi Shim'on said: [The constellation of] Pleiades binds the fruit [giving it shape and substance] and [the constellation of] Orion draws it out between knot and knot [giving it fullness]. [Gen. R. 10:6].

The Zohar, book of Jewish mysticism, adds:

All the stars and constellations in the heavens were appointed to be rulers and commanders over the world... There is not a single blade of grass in the entire world over which a star or a planet does not preside, and over that star one [angel] is appointed who serves in the presence of the Holy One Blessed Be He, each according to his merit. [2:171d]

The Zohar even goes so far as to give astrological reasons for the commandments. [3:251a–b, Raya Meheimna].

The Jewish historian Josephus tells us that astrology was common among Jews 2,000 years ago, and even that Jewish interpretation of celestial signs was partly responsible for the disastrous revolt against Rome. [Josephus, Wars 6:288ff]

Among the giants in the Jewish world, Maimonides, alone, very strongly opposed belief in astrology. In that he went against the tide

of his time and later (or earlier) times. Without mincing words, he said:

Astrology is a disease, not a science... It is a tree under whose shadow all sorts of superstitions thrive. ... Only fools and charlatans lend value to it.
[Responsa 2:25b]

In his *Letter on Astrology*, he adds:

-Fools have composed thousands of books of nothingness and emptiness [on astrology]... Men, great in years but not in wisdom, wasted all their days in studying these books and imagined that these follies are science. They came to think of themselves as wise because they knew that science... All the things that man finds written in books, he presumes to think of as true—and all the more so if the books are old.

-And since many individuals have busied themselves with those books and have engaged in discussions concerning them, the rash fellow's mind at once leaps to the conclusion that these are words of wisdom... This is why our kingdom was lost and our Temple was destroyed and why we were brought to this; for our fathers sinned and are no more because they found many books dealing with these themes of the stargazers, these things being the root of idolatry... They erred and were drawn after them, imagining them to be glorious science and to be of great utility.

-The science of the stars that is genuine science is knowledge of the form of the spheres, their number, their measure, the course they follow, each one's period of revolution, their declination to the north or to the south, their revolving to the east or to the west, and the orbit of every star and what its course is... This is an exceedingly glorious science... [The Talmud says:]

He who is able to [learn from Gentiles to] calculate the cycles and planetary courses but does not, one may hold no conversation with him... It is written, "You shall not learn to do [after the abomination of those nations]", [Deut. 18:9] [implying], but you may learn [what is not an abomination] in order to understand and instruct! [Shabbat 75a]

But as for these assertions of the stupid astrologers, they are nothing... A man should never cast his reason behind him, for the eyes are set in front, not in back...

[Rambam, Letter on Astrology]

He then tackles the thorny point that many Talmudic rabbis believed in astrology:

I know that you may... find sayings of... sages in the Talmud and Midrashim whose words appear to maintain that at the moment of a man's birth, the stars will cause such and such to happen to him. Do not regard this as a difficulty... Possibly the matter was hidden from them. Or there may be an allusion in those words. Or they may have been said with a view to the times and the business before them. (You surely know how

many of the verses of the Torah are not to be taken literally...) [Rambam, Letter on Astrology]

A later astrologer added:

There is a special irony in Maimonides' position, considering how clearly astrological cycles map some of the most important happenings of his life!

Yet superstition dies hard. Despite Maimonides' great prestige, his criticism of astrology had practically no influence on subsequent Jewish writers. On joyful occasions, Jews everywhere still congratulate each other by saying *Mazal tov*! To be fair, it is usually understood as "Good luck", or "Well done", but still, it literally means "A good constellation"! Even the rationalistic Gersonides, from 14th-century France, said that all life is predestined by the positions and movements of the stars, although he added that astrology often fails because we don't know enough about the positions and movements of the stars, and because "the intellect and [free] will carry us beyond the limitations of the stars." [Milhamot HaShem 2:2]

So what is the Jewish bottom line today? Jewish law takes a clear stand against astrology. The Code of Jewish Law says:

One should not consult astrologers, nor should one cast lots to determine the future. [Shulchan Aruch, YD 179:1].

Needless to say, modern science has vindicated this position and made astrology highly unlikely to be accurate.

Before we conclude this study, let us stress that the quest for knowledge has always been particularly strong in Judaism, in spite of occasional doubt as to whether it is wise to engage in it.

The quest for knowledge in Judaism

In the Torah, after hearing a plea from Moses on behalf of the Israelites, God decides to forgive the sin of the golden calf, and assures Moses that God's presence will accompany them in their trek across the desert. But Moses is not satisfied. He wants more. The Torah says:

And Moses said to God: I beg you, if I have found favor in your sight, show me now your way, that I may know you...Show me your glory...

And God said, I will make all my goodness pass before you, I will proclaim My name before you; and I will be gracious and show mercy to whom I please...

But You may not see my face; for no man shall see me and live...

You shall see my back; but my face shall not be seen. [Ex 33:13-23]

Why not? What are we talking about here? First, does God have a face? That's not a Jewish concept. Even if so, is this face so terrifying that people die just from looking at it? Does it radiate so much light that people go blind and die when they see it? Surely not. There must be a figurative meaning here. Is the resulting "death" a punishment? Or an automatic consequence? Or a self-fulfilling prophecy?

I believe Moses is puzzled by this deity he cannot comprehend. He wants answers to ultimate questions. What is God's plan? What are God's motives? Why does evil exist? Moses wants *knowledge*. But God does not want to reveal this knowledge. God said he would drop hints - his "presence", his "goodness", his "back" - but God will not give straight answers.

A similar theme is picked up in the Book of Job. Job criticizes God for all the undeserved catastrophes showered on Job, and asks the same questions. God answers the questions with questions, in an extraordinary passage taking up 103 verses. God's questions merely expose Job's ignorance of God's plans, but provide no answers:

God answered Job out of the whirlwind and said: [Job 38:1]

Where were you when I laid the foundations of the earth? [Job 38:4]

Tell me, if you know, who determined its boundaries? [Job 38:5]

What were those foundations attached to? [Job 38:6]

Do you know what happens after death? [Job 38:17]

Did you go inside the earth? Tell me, if you know it all. [Job 38:18]

Come on, you are old enough to know. [Job 38:21]

Where does the rain come from? [Job 38:28]

And the ice? [Job 38:29]

Can you shoot lightning bolts? [Job 38:35]

Do you think you can just nullify my judgments, condemn me, and justify yourself? [Job 40:8]

This is what it says, verbatim! Yet Jews have always valued the pursuit of knowledge in all its forms. Education is always uppermost on the Jewish agenda. Einstein once said,

The pursuit of knowledge for its own sake, an almost fanatical love of justice, and the desire for personal independence - these are features of the Jewish tradition that make me [happy] I belong to it. [Albert Einstein, The World As I See It]

When I was growing up in Egypt, my father, a man of modest means, made sacrifices to send all his children to the best private schools. He used to say, "The Arabs can take everything from you -- your money, your house, your possessions, even the shirt on your back. But there is one thing they cannot take, and that's what's inside your head." Sure enough, they did take everything we had, and I survived with what my father arranged to have put inside my head.

The traditional morning prayer asks God:
Channenu me'itcha de'ah, bina, v'haskel
Grant us knowledge, understanding, discernment.

We are always thirsty for more knowledge. So how can knowledge be bad?

Well, the Sources seem to say that, indeed, there are things we are not meant to know and should not inquire about. Let's begin with the story of creation, in Genesis:

And God commanded the man saying, 'Of every tree of the garden you may freely eat; but of the tree of knowledge of good and evil you shall not eat, for in the day you eat of it you will surely die.' [Gen. 2:16-17]

[But] the snake said to the woman, 'You will not surely die! God knows that when you eat of it, your eyes will be opened, and you will be as gods, knowing good and evil.' [Gen. 3:4]

And God said, 'Now that the man has become like one of us, knowing good and evil, what if he should stretch out his hand and take also from the tree of life and eat, and live forever!' Therefore God banished him from the garden of Eden... and placed at the East of the garden of Eden cherubim, and a flaming ever-turning sword, to guard the way to the tree of life.' [Gen. 3:22-24]

So there is knowledge that God does not want us to have yet. God does not want us to be like God. Later, in Deuteronomy, the Torah says:

Ha-nistarot l'Hashem elokenu

*v'ha-niglot lanu ulvanenu 'ad 'olam
la'asot et kol divrei hattorah hazzot*

The secret things belong to the Lord our God
and the revealed things belong to us and to our children forever
that we may follow all the words of this teaching. [Deuteronomy 29:28]

In an unusual flourish for emphasis, the words “For us and our children” include extra dots above each letter on the scroll.

Psalm 115 says:

The heavens belong to the Lord, but the earth He gave over to man. [Ps. 115:16]

Ecclesiastes says:

As you do not know the path of the wind, or how the body is formed in a mother's womb, so you cannot understand the work of God, the Maker of all things. [Ecclesiastes 11:5]

The Mishna in Hagigah has similar admonitions:

One should not discuss illegal unions unless there were three beside him, nor the creation unless there were two beside him, nor the divine chariot with [only] one individual, unless he was a wise man and had much knowledge of his own.

Everyone who tries to know the following four things, it would have been better for him if he had never come into the world: What is above, what is below, what was before [creation], and what will be after [all is destroyed]. [Hagigah 2.1 -- 11b]

The Gemara in Hagigah quotes the apocryphal book of Ben Sira:

Do not seek out the things that are too hard for you, and do not inquire in the things that are hidden from you. Instruct yourself in what is permitted; you have no business with the secret things. [Hagigah 13a; Ecclesiasticus 3:21-22]

The Talmud [Hagigah 14b] records the story of four rabbis who ventured into mysticism. Ben Azzai gazed and died. Ben Zoma became insane. Elisha ben Avuyah left Judaism and became an apostate. Only Akiva emerged unscathed, and went on to become one of the greatest rabbis in our history. On Ben Zoma becoming mad, the Talmud adds:

To him the passage [in Proverbs 25:16] may be applied: ‘Have you found honey? Eat as much as is enough for you, lest you consume too much of it and have to vomit it forth.’ [Hagigah 14b]

What do we make of all these passages?

One possibility is that God does not want us to suffer. God is withholding certain knowledge out of concern for our welfare. I can accept that, even though it's not clear to me what kind of knowledge could possibly cause me to suffer. (How can anything be weirder than quantum mechanics or relativity?)

Actually, it's not knowledge **itself** that God wants to shield us against, but **premature** knowledge of things we are not psychologically prepared to know. And the 'premature' part applies to the individual, not to humanity as a whole. Note that the Talmud says, "It would have been better FOR HIM if he had not come into the world". The key part is "FOR HIM".

In the same vein, when God is concerned that people might live forever, it may be because it would not be good **for people** to live forever. It is easy to figure out why: If we lived forever, we would have very little incentive to achieve anything, since there is always a tomorrow; and besides, young people would never get a chance to make progress by trying out new ideas, if their elders stay in charge forever.

But, if so, as we pursue knowledge, how do we know what's permitted and what's not? How do we know if we are ready or not? The tradition drops some hints. For example, the Talmud says:

A five-year-old begins Scripture; a ten-year-old begins Mishnah; a 13-year-old becomes obliged to observe the commandments; a 15-year-old begins the study of Gemarah; an 18-year-old goes to the marriage canopy; a 20-year-old begins pursuit [of a livelihood]; a 30-year-old attains full strength; a 40-year-old attains understanding; a 50-year-old can offer counsel... [Pirkei Avot 5:25]

But still, that answer is incomplete.

A second possibility, as some commentators have suggested, is that we may physically not be able to understand certain things -- that we are just not smart enough. They say, "Can a monkey understand the theory of relativity?" I reject this view most emphatically.

-First, even if it's true, we cannot possibly know that it's true. We don't know the limits of our mind.
-Second, God did give us a mind. So God must want us to use it and TRY to understand. God also gave us the gift of curiosity. We WANT to know. It may take us 100 years or 10,000 years, but, as a scientist, I have faith that we will continue to understand more and more of the universe around us. Anything less is a defeatist attitude.
-Third, if that's the explanation, then God is just admonishing us against wasting our time, which doesn't seem to square with the urgency of the command to avoid certain lines of inquiry.

A third possibility is that God may fear that if we understood the Divine Plan, we could intentionally mess it up. Its success depends on us being ignorant of its details. That's the predominant feeling *I* get from reading these quotes, and this explanation may be right on the money.

What do we conclude from all this? Well, the world has always been leery of new knowledge, for the same reason change of any kind is not always welcome among people who feel reasonably satisfied. The new knowledge can be used for good or for evil. The new knowledge has given us the information explosion (through the Internet) as well as weapons of mass destruction. Judaism teaches that all knowledge is good, but only when you are ready for it. Unfortunately, it does not make it easy for us to determine *when* that is.

We conclude by examining the notion of faith, which, willy nilly, runs our lives.

Faith in Judaism and Science

The phrase Jews know best in the Torah is:

Sh'ma Yisrael, HaShem Elokenu, HaShem echad!

Hear, O Israel: the Lord our God, the Lord is One. [Deut. 6:4]

This simple statement encapsulates the essential part of Judaism: There is a God, and only one. It is obviously a matter of faith. Have you ever paused to think just what it is that you believe in, what drives

your actions, what is your “starting point” in life? Let's explore some possible starting points and examine ultimate issues from a Jewish point of view.

First, what is faith? Faith is what you accept without proof. It informs and drives your actions.

Now, the rationalist may respond: “I accept nothing without proof. Without hard evidence, clear to all, nothing can be accepted as true.” Actually, this is impossible. You must have a starting point. Logic and reason are only the road used to travel from unquestioned premises to conclusions. Logic and reason just say: “If this, then that.” You cannot skip the “If this” part. It would be “irrational”. There must be faith at the beginning.

These premises are called “axioms” in mathematics. Yes, even mathematics requires unproven statements as starting points. For example, standard geometry begins with Euclid's axioms. Change these axioms and you get a different geometry, which is also useful. Einstein's general relativity showed that our world obeys a geometry different from Euclid's, because space is curved.

Even the scientist has faith, much as he may deny it:

- He believes that there is order in the universe, that there are laws, that things are not random. If he did not believe that, he could not be a scientist. He'd be selling insurance. His job is precisely to discover these laws, and he could not do that if he doubted their very existence.

- He believes he can understand these laws. If he thought they were beyond his comprehension, he would not even try.

- He also believes these laws are true everywhere, that they extend throughout all time and space. If the laws were to change from day to day or from one corner of the universe to another, they would not be laws.

- He also believes there must be a single unified theory that explains everything. There is no requirement that there be such a theory. It is just an article of faith. This belief, as noted earlier, stems from our biblical quote: God is One. The idea that God is One leads the scientists to try to unify and simplify their theories, to show that even very different phenomena can derive from the same basic law.

Sometimes the faith of the scientist can be misplaced. In the 19th century, scientists believed that two experiments performed under exactly the same conditions must produce exactly the same results. One day they discovered they don't, and quantum mechanics was born.

Some will say: "I accept only what I see or feel. These are my starting points." But these starting points can lead you astray. Things are often not what they seem. There are mirages, hallucinations and clever manipulations. Our knowledge is incomplete. For example, based on our immediate observations, the earth is flat and the sun moves around it, but this is not so.

Some will say: "I just follow my instinct". But where does this instinct come from? It comes from inherited teachings, which flow from the faith of ancestors. Judaism teaches that there are two types of faith. The first is *emunah*. It is specific and expressible as "propositions", such as "God is One" or "God rewards the righteous". The second is *bitachon*, which can be translated as "trust" or optimism. It is diffuse and non-specific. For example, the Talmud tells of a robber about to steal, and says, "God, help me!" He has the chutzpah to trust that God will help him, even if it is to break God's own commandments! [Berachot 63a, according to En Yaakov]

The only faith mentioned in the Bible is monotheism and chosenness, as related in the Book of Isaiah:

You are My witnesses, says the Lord, and My servant whom I have chosen; so that you may know Me and believe Me, and understand that I am He. Before Me no God was formed, and neither shall any be after Me. [Is. 43:10]

Let us turn to the concept of "God". Can one "prove" the existence of God? No. No proof of the existence of God is possible. No matter what "miracles" you may witness, how do you know God is causing them, and not just an alien from outer space impressing you with his advanced technology? You can't. So it's a matter of faith. After all, how hard would it be to impress a primitive man who lived centuries ago that you are God? You land in his village in a helicopter; speak to him through a loudspeaker, show him all kinds of modern technology; if you are mean you show him who is boss with machine

guns and dynamite; and you heal his sick loved ones with five dollars' worth of antibiotics. The "alien" in question is not God, but can make you believe he is. He has no answers to ultimate questions.

Now we need to define "belief". What is the meaning of "I believe"? Is it just a warm fuzzy feeling? That would be irrelevant to "truth". Is it something you are willing to state in public? You may feel compelled or socially pressured to say it. No, belief must be provable by action, or else it is meaningless.

I can playfully manufacture a test scenario. Suppose aliens from outer space were to land and tell you: "We have video recordings of all of human history, taken with powerful remote cameras. We know what happened for certain. To prove it, here are some scenes from your life you'll recognize. Now answer this: Did Moses part the sea? We have taken your children hostage and will kill them if you answer wrong." It's only then that you'll know whether or not you believe Moses parted the sea!

But, until such a scenario comes to pass, you can't be sure you "believe" biblical accounts. In matters theological, "belief" is a meaningless term. For example, I may be strongly attached to Judaism as a whole, I may find its approach, track record, teachings, rituals, etc., inspirational, satisfying, useful, and right on the mark; but I don't know what I believe if it's not backed by some action of mine. That is why belief has never been important in Judaism, in spite of an attempt by Maimonides to create a Jewish creed. Judaism never emphasized belief, only commandments, only action.

For example, I believe in gravity, so I won't jump off a cliff, even when I am in serious danger, because I know for certain I will die if I jump. My behavior proves my belief in this narrow point. Likewise, I will support paying for the building of satellites that improve communications, because I believe gravity will make them stay in the right orbit. My actions demonstrate my belief, to myself and to others.

Let me illustrate with an anecdote about the Danish physicist Niels Bohr. Bohr was half Jewish, professed to be a secular humanist, and won the Nobel prize for his contributions to quantum mechanics. One day, so the story goes, Bohr was walking home with some of his

graduate students. When they arrived, the students noticed a horseshoe on Bohr's front door. They were horrified. "Professor!" they said, "how can you, of all people, believe in such superstitious nonsense!" Bohr smiled, saying: "Relax. I don't believe for a minute that the horseshoe will bring me luck. I agree it's all baloney and hogwash. However, I am given to understand that the horseshoe works whether or not you believe in it."

The important conclusion here is that most theological discussions are futile, and tragic when they result in violence and loss of life, as they often did outside of Judaism.

As mentioned earlier, Judaism does not directly require faith, or belief. Judaism emphasizes "action" commandments, unlike other religions. In the Midrash, God is quoted as saying: I don't mind if my people stopped believing in Me, as long as they follow My commandments:

It is written [in the Book of Jeremiah], "They have forsaken Me and have not kept My law." [Jer. 16:11] This means [it would have been better if] they had forsaken Me, yet kept My law, because the light of My law would have led them back to the right path. [Lam. R. Prologue 2]

The only Jewish test of belief is: How does it affect your actions? If it doesn't, Judaism says: Don't worry about it.

Some people have evolving faith. They say: "These are my starting points today, but I reserve the right to change them." This is OK and encouraged, as long as you truly believe in SOMETHING today.

If one were to ask me for my own statement of faith, I would say:
There are laws governing the universe and we can understand these laws. Behavioral laws are derived from the Torah and natural laws from scientific observation.

Let me make a few comments about it:

-First, the statement rejects the assertion that there are things beyond our comprehension, things that our brain cannot grasp. I emphatically reject the view: "We may physically not be able to understand certain things. Can a monkey understand the theory of relativity?" There are two reasons for this:

- First, even if it is true that there are things we can't understand, we cannot possibly know it.
- Second, we were given a mind to try to understand things. It would be defeatist to reject this gift.

- Second, the statement does not say: "There is order in the universe". Order is a matter of perception. At one level (say, microscopic), things may seem chaotic, but at another level (say, macroscopic), order can be perceived in statistical laws. This is exemplified by quantum mechanics, classical statistical mechanics, the theory of heat and diffusion, etc. Also, "order" may imply "determinism" to some, and so it is avoided.

- Third, the statement does not say: "We can attain all knowledge". This would imply knowing the future with certainty, and hence determinism. The laws in question may well be statistical, as in quantum mechanics. Knowing all the laws does not mean knowing all there is to know, because of built-in limits, such as the speed of light or the uncertainty principle.

- Fourth, the statement does not say "We will have answers to all questions". Some questions are the right questions to ask, and some are the wrong questions to ask, and we have no way of knowing which is which in advance. For example, a hot question 2,000 years ago was: "What does the Earth rest on?" We now know this is the wrong question to ask. Moreover, the laws themselves may imply that some questions, although not "the wrong question", simply cannot be answered with certainty, such as "What will I do tomorrow?" (because of free will) or "What will that particle do next?" (because of quantum mechanical uncertainty).

- Fifth, the statement does not say "We will know all the reasons, all the purposes". The laws themselves may reveal purpose, or they may not.

- Sixth, the statement does not say "We WILL discover all the laws", only that we can understand them if explained to us. Some laws may not be discoverable or verifiable by experiment (such as parallel universes), and must remain in the domain of speculation, or to complete a compelling theory. The laws may require that some

portions of the universe be inaccessible. So a theory, while “correct”, may be unverifiable.

It is important to note that a theory always remains a theory. No cause-to-effect relationship can EVER be proved. Only 100% correlations can be observed. No one knows if one day a new fact will invalidate a theory that has so far been successful. Consider two examples: (1) I order the sun to rise every morning and the sun does indeed rise every morning, and (2) I slam my fist on the table and you hear a sound every time. Did the first event cause the second? We don't know. All we know for sure is that there is a 100% correlation. It does not prove that there is a cause-to-effect relationship. The fact that such a relationship is highly implausible in the first example and highly plausible in the second just reflects biases stemming from our experience.

Seventh, although the statement does not mention “God”, or the realms of mysticism and the paranormal, it does not exclude them. They would become part of the laws. Some religious concepts may find their way in those laws in a different language.

Eighth, the statement does not profess faith in “human goodness”, in “progress”, in “love”, and other hard-to-define and hard-to-measure characteristics. They could, however, be embedded in the laws in a different, quantifiable form.

Ninth, the statement must not necessarily be understood in the sense that science will explain everything. An Orthodox Jew can look at the statement and say: “I fully agree. You will find all these laws in the Torah”.

Tenth, the statement does not imply that we will be bored to tears living in a world in which we know everything, with nothing left to discover. The laws themselves may take care of that problem. For example, the laws of quantum mechanics imply that we can determine probabilities of events occurring, not certainties. There are always “surprises” and “unknowns” to spice up life. Also, a law may be that the laws themselves change with time, perhaps unpredictably, or according to some “superlaw”.

Eleventh, the statement says nothing about whether the pursuit of knowledge (that is, the attempt to discover these laws) is a desirable thing. That is a subjective assessment. As we saw earlier, quotes from the Jewish tradition point to the necessity of being careful with new knowledge.

Finally, the statement does not exclude belief in an afterlife. There are two arguments in favor of an afterlife. The first is religious: The resurrection of the dead is a rabbinic doctrine, included in Maimonides' thirteen principles of faith. The second is scientific: Nature is thrifty, not wasteful. Conservation laws appear all over physics: Conservation of mass-and-energy, of linear and angular momentum, of spin, of electric charge, etc. The thought that after death nature would completely waste a mind and all its contents and potentialities does not track with all these conservation laws.

To summarize: We turn to science for facts and to Judaism for values. Science cannot give us values and Judaism cannot give us facts. Science describes how the world works, Judaism explains why the world works, and how we should act in it.

Let us give the final word to Albert Einstein:

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.