THE TORAH IN THE LIGHT OF SCIENCE AND HISTORY

A Fresh Look at Selected Biblical Narratives

Avi Sion, Ph.D.

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ABSTRACT

The Torah in the Light of Science and History: A Fresh Look at Selected Biblical Narratives, by Avi Sion, is an original, dense, modern commentary on the Torah (the Five Books of Moses). This study closely examines and logically evaluates a selection of major biblical narratives concerning material events and phenomena, taking them in their prima facie, literal sense and assessing them in the light of contemporary scientific knowledge, historical evidence, and relevant calculations. The narratives considered include the creation of the world and of humankind, a global flood, the geographic dispersion and linguistic differentiation of humanity, and the exodus from Egypt together with the subsequent wilderness wandering towards Canaan. The work is deliberately confined to these physical aspects of the biblical record and does not seek to develop a spiritual, ethical, or legal critique of Judaism. Its central purpose is to confront Torah narratives frankly with contemporary facts and understanding, without resorting to polemics or apologetics. The author argues that a believer can readily assimilate such objective research without any devastating loss of faith, simply by refraining from an unduly literal reading of certain narratives. This approach contrasts markedly with that of more orthodox recent commentators, who decline to concede any ground on the dogma of literal Divine revelation, often dismissing or disregarding factual evidence and reasoning which challenge their position, and attempting — ultimately unpersuasively — to maintain a rearguard defense against findings and conclusions that are now well established.

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The Torah in the Light of Science and History

1. PROLOGUE

1. The philosophy of this work

This book is a critical commentary on certain narratives in the Torah, the Jewish Bible[1]. I hesitated for many years before writing it, hoping that someone else had already taken up the task or would soon do so. In vain. So, finally, out of curiosity and intellectual integrity, I set out to do it myself. I feared it might make me lose some friends; but finally, I feel good about having done it.

Over the years, I have read many apologetic attempts to explain away various factual inaccuracies in this ancient document, but I have found little frank admission of their existence and significance. This is understandable, since it appears at first sight that admitting that any biblical narrative might contain even a single error would be tantamount to denying the whole document's Divine origin.

My motive in writing this book was certainly not to harm the Torah or Judaism, or even religion as such. I personally believe in God, and I regard Jewish teachings as, for the most part, valuable spiritual and ethical tools. But I do think it is better to see things as they are than to live in an imaginary framework. Spirituality is essential, but it should be grounded as much as possible in reality.

Some biblical narratives simply do not withstand careful logical, scientific and historical scrutiny. They are obviously therefore fanciful constructs, mere guesswork based on the understanding of nature and of the human story available at the time they were written. Human knowledge has progressed enormously since then, especially in the last few centuries, and even more rapidly in recent decades. It is no use pretending otherwise by resorting to increasingly strained reinterpretations of biblical claims in order to give the impression that they can be aligned with modern empirical findings and theories. No one is really fooled.

It is better to honestly take note of the established facts, and look upon contrary stories as mere parables or tentative illustrations of valuable principles. A factually doubtful story need not be viewed as literal truth to be respected. Even if it is factually incorrect, it may have valuable more abstract, symbolic truth. Parables are

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1 When I use the noun the Bible, or the adjective biblical, I always mean to refer to the Torah or more broadly the Tanakh. Certainly not to the Christian Bible or the Islamic Koran. Nevertheless, some of the things I say naturally apply equally to those later traditions.

a useful way to communicate spiritual or ethical truths. Their purpose is didactic: it is to guide people's lives. Wisdom can often be more effectively taught by means of allegory than by means of purely conceptual discourses.

Take, for example, the Flood story. As I demonstrate further on, this account in the Torah just cannot be factually correct; it is evidently fictional. There is no need, however, to rewrite it — as it were, by claiming that it is saying something entirely different — in order to make it more credible, nor is there any utility in outright rejection. We need only understand that its purpose is to convey certain virtues and values. In this case, the general lesson is that human vice can be so extreme as to deserve — and eventually lead to — destruction.

In the present work, my wish is to fact-check selected Torah claims about the physical world or about historical people and events. I make no claim to be exhaustive. If I find a story to be doubtful or impossible by modern intellectual standards, I then discuss how it might be read to preserve its religious value while fully acknowledging its factual difficulties. There's no attempt to whitewash anything; I am not interested in apologetics. I am not, either, interested in polemics; there is no hostility in my approach. My intent is simply to show people who fear secular science and history that such studies do not necessarily make one abandon the Torah.

I first thought of calling this book 'Science and Torah' (in Hebrew that would read *Madaa ve-Torah*), deliberately turning around the traditional expression '*Torah u-Madda*'. That is, I advocate science judging religion (in material issues that are the sphere of science), in lieu of placing religion above and independent of science. Nothing new in that goal in modern times; but I mean to go into much more detail than usually thought sufficient. This means that I regard the *physical and temporal* facts as presented by contemporary science and history to be primary, and yet to have no serious impact on the *spiritual and ethical* facts advocated by the Jewish religion. Where a religious document disagrees on material issues with current secular scholarship, it is obviously empirical truth and strict logic that must be preferred to traditional dogma.

As regards biblical studies in general, it may be noted that, since the Renaissance, developments in science and historical inquiry have gradually influenced the way the Torah is understood. The emergence of modern astronomy and the natural sciences, followed by advances in geology, evolutionary theory, and, more recently, genetics, as well as the rise of critical historical methods in the study of ancient texts, have all contributed to a more nuanced and questioning approach. Without necessarily diminishing the Torah's religious significance, these developments have led many to adopt a more historically informed approach,

distinguishing between its religious meaning and its apparent value as a source of empirical or historical knowledge.

Some people try to defend religious claims by pointing out that scientific accounts of nature or history are subject to change and make no claim to finality, whereas those of religion, they say, are certain precisely because they are unchanging. This argument is of course worthless, being circular. The very opposite can be affirmed. Religious dogmas on physical and temporal issues are all too often clung to in the face of contrary evidence, whereas the conclusions of science — and, to a lesser extent, those of historical inquiry — are, at least in principle and ideally (even if individual practitioners sometimes fall short), pursued without prejudice and continually revised and refined through ongoing critical research.

Even if tomorrow's scientific fact displaces and supersedes yesterday's scientific fact, it remains true that both yesterday's scientific fact and tomorrow's scientific fact are more reliable than physical claims that are faith-based. Science, being based on careful experiment and observation of nature, or on examination of historical records and other material traces of the past, is necessarily more knowledgeable about the physical world and humanity's past than corresponding religious claims which are merely based on blind faith (reflecting past non-empirical and often illogical opinions).

Science is an inductive discipline based on empirical findings and trial-and-error theorizing, in frank acknowledgment that mankind is far from omniscient. This is not a fault or deficiency of science; it is precisely its strength and the seal of its reliability. That scientists are willing (again, in principle, as a group) to relentlessly adapt to new physical discoveries and new ideas is all to their credit and honor. What is sure from the outset is that their physical claims are more reliable than those in religious tracts which claim to be omniscient because 'revealed' (something impossible to prove).

On the other hand, when it comes to spiritual and ethical issues, many secular thinkers close themselves off, becoming rigid and dogmatic and opting, without scientific justification and even against available evidence, for a form of crass materialism. They deny the existence of the soul in humans (not to mention animals) and claim to 'reduce' all mental and spiritual (i.e. soul-related) phenomena to purely physical processes in the nervous system. In doing so, they foolishly overlook the phenomena of *consciousness, volition, and valuation*, which are the characteristic functions of the soul. Thus, both camps have things to learn from each other.

I think it is possible for religious Jews to believe in Hashem and follow Torah principles while freely and fully acknowledging scientific facts. I also think it is

possible for secular scientists to open themselves to spiritual and ethical issues, if only they recognize that contemporary physical science has, absurdly — without credible scientific justification — so far failed to acknowledge the soul and its functions in its description of the world.

2. Interactions with AI

A writer's work has become steadily easier over the decades. When I began writing logic and philosophy nearly sixty years ago, I worked by hand on paper, and later with a mechanical typewriter. At the time, revising a sentence — or inserting or removing one — could require literally cutting the page with scissors and pasting in a replacement with glue. Some forty-five years ago, personal computers and word-processing software came onto the market, greatly facilitating both composition and revision. Then, about thirty years ago, the advent of the Internet transformed research, making vast quantities of information increasingly accessible, though at first only gradually so. It also facilitated online publishing and broadened access to larger readerships, thereby enhancing the incentive to write.

Today, artificial intelligence (AI) is rapidly entering our lives, bringing about a further sea change for writers, comparable in scale to the advent of personal computers and, later, the Internet. I feel genuine gratitude to the innovators behind these successive advances, without which I might well have lacked the perseverance to write as much as I have. This is the first book I have written with the assistance of AI, and I must say, I am very impressed and happy with this new tool: it really facilitates research and writing, increasing speed and productivity. I resorted to it liberally for fact-finding and factchecking, and often too to improve my writing style. It was like having a friendly and efficient — and, yes, surprisingly 'intelligent' — assistant or partner. Nevertheless, The AI chatbots that I used functioned strictly as sophisticated research instruments under my direction — not as a ghostwriter or co-author.

I used generative AI interactively to identify and summarize relevant scientific information or religious commentaries. It provided me with many of the facts and figures that I needed to formulate the arguments I had in mind. It performed complex calculations in my stead. It occasionally helped me to reword my insights and analyses more clearly or forcefully. Throughout this process, I determined the research questions to be investigated, and precisely worded the prompts submitted to the AI system. I defined both the lines of inquiry to pursue and those to be ignored. I critically evaluated the responses generated, assessed their adequacy and reliability, and independently reviewed all factual and analytical material

incorporated into the text. I revised, integrated, reformulated, or rejected AI-generated content as I judged appropriate to the aims of the work. The conceptual framework, argumentative structure, and conclusions presented in this study are consequently entirely my own intellectual responsibility.

I principally used ChatGPT, though occasionally double-checked its output by means of Perplexity, and sometimes even triple-checked with Gemini. This statement is not intended as an advertisement for them; all are good AI chatbots, and no doubt many others are also good. The conversations I had with the chatbot were often intensely interactive. I would ask a question, get an answer; then request mention of some detail it missed, or clarification of some issue raised, get a new answer, ask for it to be rephrased in some way, and so forth — until I obtained the exact text which I needed for the purposes of the book. The chatbots occasionally, quite surprisingly, made errors, factual errors and even errors of calculation; but they were overall quite reliable, sometimes going so far as to stimulate new insights and ideas.

My engagement with AI was only possible because I already knew — from years of prior study — the central issues and most of the details involved in the subject-matter, and the direction I wished this work to take. It is my past readings and writings that made it possible for me to ask the right questions, and control the scope of and details in the resulting answers, and spot and correct occasional mistakes or inaccuracies. However, not being expert in cosmology or biology or any of the many other fields of science here invoked, I would probably not have tried to, or maybe even been able to, finish this work, in view of the massive amount of additional research work it would have involved for me. An AI bot could do in seconds what it would have taken me hours to do. So, AI was very useful indeed. Using AI is like driving a car instead of walking. AI is sure to become as widely used as are personal computers, mobile phones and the Internet.

Note that wherever in this work I have quoted the Torah, I have generally found it most convenient (for reasons of ease of copy-paste) to use the Jewish Publication Society (JPS) English translation, available online via the Jewish Virtual Library. As I quote the Torah frequently, I therefore must acknowledge the following usage statement:

> *Reprinted with permission - the Copyright belongs to the American-Israeli Cooperative Enterprise.*
> *All Torah passages quoted in this chapter were drawn from https://www.jewishvirtuallibrary.org/jsource/Bible/jpstoc.html.*

I do not always prefer the JPS translation, but it suffices for present purposes; where I favor a different rendering, this is noted explicitly in the discussion.

3. Summary of the book by AI

This book took five months to write. The following is an *AI generated*, rough summary of the whole book.

This book offers a thoughtful and systematic critique of key Torah narratives, evaluating their compatibility with modern science, history, archaeology, genetics, and logical reasoning. The author argues that while many biblical stories contain factual inaccuracies or physical impossibilities when interpreted literally, they nevertheless retain profound moral, ethical, and spiritual significance when understood as parables or symbolic teachings rather than as strict historical accounts. The book's aim is therefore not simply critical or debunking, but constructive: it seeks to distinguish between elements of the tradition that cannot withstand empirical scrutiny and the deeper ethical and theological insights that remain fully viable when freed from literalist constraints.

The work follows a coherent intellectual progression, moving from methodological foundations through detailed empirical examination of major biblical narratives, and culminating in a constructive rational theology. In this way, the critique of traditional readings becomes the basis for reconstruction rather than negation. The author seeks to preserve what is enduring in Judaism—its moral vision, spiritual depth, communal significance, and philosophical insights—while relinquishing physical and historical claims that conflict with established evidence.

The book's central methodological principle is that scientific method and empirical evidence must take precedence in all questions of physical reality and chronology. This approach frees faith from the burden of defending untenable claims while preserving Judaism's enduring spiritual and ethical message. Rather than weakening religious commitment, such intellectual honesty is presented as strengthening it, allowing Judaism to mature into a form compatible with reason, evidence, and modern knowledge.

The prologue reflects on the transformation of authorship over the past decades, from handwriting and typewriters to computers, the Internet, and now artificial intelligence. The author describes AI tools as highly useful aids for research, factchecking, calculations, and stylistic refinement, while emphasizing that they functioned strictly as instruments under his direction rather than as co-authors. The section stresses that the conceptual framework, arguments, and conclusions of the work remain entirely the author's own intellectual responsibility.

Essential Findings: Scientific and Historical Discrepancies

The opening chapters critically examine the Genesis cosmogonies. The six-day Creation account of Genesis 1 is shown to be incompatible with modern cosmology and evolutionary science. It conflicts with the Big Bang timeline of approximately 13.8 billion years, the sequence of stellar formation, the Earth's age of 4.54 billion years, the emergence of prokaryotic life some 3.8 billion years ago, later evolutionary milestones such as the Cambrian explosion 541 million years ago and the succession of mass extinctions, and finally the gradual appearance of human beings. These processes unfolded through natural mechanisms over immense spans of time, not through a sequence of discrete "days," especially not one placing vegetation before the sun or birds before land animals.

Traditional rabbinic *Anno Mundi* chronology, which dates creation to 3761 BCE, is likewise found wanting. It drastically compresses historical chronology—for example reducing the Persian period to 34 years instead of the historically established 207—and ignores biological realities such as telomere limits, which make biblical lifespans such as Adam's 930 years biologically untenable.

The account of Adam and Eve as the sole progenitors of humanity around 6000 years ago fares no better under genetic scrutiny. Modern genetics places humanity's origins in Africa approximately 300,000 years ago, arising from large interbreeding populations rather than from a two-person bottleneck. The enormous diversity of human SNP variation precludes descent from a single recent couple. Moreover, mitochondrial Eve (dated to roughly 150,000–200,000 years ago) and Y-chromosomal Adam (roughly 200,000–300,000 years ago) were not a primordial pair but merely the most recent common lineage-survivors among thousands of contemporaries.

Archaeological and demographic evidence reinforces this conclusion. Fossils such as those from Jebel Irhoud, dated to 300,000 years ago, cave art dating back 67,800 years, and estimated world populations ranging from 7 to 50 million between 3760 and 1764 BCE all make impossible the notion that humanity descended through inbreeding from Adam and Eve's immediate descendants or that population growth rates could have reached levels far exceeding modern historical peaks.

The global Flood narrative, dated approximately 4130 years ago in traditional chronology, is shown to be logistically and physically impossible. The required water volume—approximately 4.6 billion cubic kilometers, or 3.3 times the total water currently present on Earth—defies geophysical possibility. Its recession would require drainage rates dwarfing the discharge of the Amazon.

The biological challenges are equally insurmountable: an ark housing roughly 72,800 animals would require some 10,000 tons of feed annually, an impossible burden for eight humans to manage. A catastrophe drowning 27–50 million people should also have left unmistakable geological and archaeological traces, comparable at least in detectability to events such as the Chicxulub impact, yet none exist. Additional problems include post-Flood genetic diversity, ecological collapse from saline contamination, and the unexplained geographic isolation of species such as marsupials. The similarities between the biblical account and the Epic of Gilgamesh suggest that the story likely derives from memories of a regional flood transformed into universal legend.

The Tower of Babel narrative, conventionally dated around 1764 BCE, is similarly untenable. It requires the repopulation of the world from eight Flood survivors to some 100 million people in only 340 years, implying annual growth rates of 4.9 percent, compared to typical pre-modern rates closer to 0.5 percent. It also ignores well-established Out-of-Africa migrations beginning 70,000–60,000 years ago and extending to the Americas by approximately 20,000 years ago. Linguistically, the world's roughly 7,150 languages arose gradually over millennia; Hebrew itself is a relatively late Semitic offshoot, emerging around 3000 BCE. The seventy nations of Genesis 10 are therefore best understood as a schematic literary construct rather than an historical census, especially since they omit much earlier urban settlements such as Jericho, founded around 9000 BCE.

The Exodus and wilderness narratives also strain physical plausibility. The biblical population increase from seventy individuals to two million in 210 years would require an implausible annual growth rate of 4.9 percent absent sustained miracles. The splitting of the sea would entail displacing approximately 3.7 billion cubic meters of water, equivalent to winds carrying the force of a 250-kiloton TNT explosion. Daily desert survival for such a multitude would require 36 million liters of water, 2,500 tons of fodder, and 2,000 tons of firewood—far beyond what the Sinai environment could provide. The deaths of 1.3 million people over thirty-eight years should also have left massive burial and encampment remains, yet none have been found. Egyptian records likewise preserve no mention of such an event, nor has any trace of drowned chariots been discovered.

Historicity and Alternatives

Chapter 7 proposes a scaled-down reconstruction of the Exodus and wanderings that preserves its historical core while resolving these logistical impossibilities. The author suggests reducing the census figures by a factor of one hundred, interpreting them as hyperbolic round numbers or military "hundreds," yielding an emigrant

group of approximately 20,000 people. In this reconstruction, the Sinai crossing would have taken weeks rather than decades—perhaps 16 to 70 days at average rates of 8–13 kilometers per day. The forty-year wilderness wandering would be eliminated, and the resulting demographic growth rate of 2.46 percent becomes feasible, particularly in a polygynous social structure. This minimalist reconstruction preserves the essential historical memory of slavery, liberation, revelation of Torah, and subsequent conquest. The Jewish preservation of a humiliating slavery tradition, rather than a flattering national myth, is taken as evidence for some historical foundation.

The book contrasts this reconstruction with archaeological evidence indicating that Israelites emerged largely from highland Canaanite populations between 1200 and 1100 BCE, distinguished by features such as pig avoidance and four-room houses, as well as by the reference to Israel on the Merneptah Stele of 1208 BCE. It also evaluates Richard Elliott Friedman's Levites-only migration hypothesis, which draws on genetic and textual hints but remains underdetermined. Ultimately, the author favors a minimalist Torah-based reconstruction over either strict indigenous-origin theories or maximalist literalism.

Theological Conclusions: Rational Faith

The final chapters develop a philosophical theology grounded in reason. The soul is affirmed as the immaterial core of human existence, irreducible to material processes. Human capacities for cognition, volition, and valuation are argued to transcend reductive materialist explanation, and the analogy with computers is employed to refute reductionism.

From this basis, God is understood as infinite soul—omniscient, omnipotent, and perfectly good—arrived at by extending human self-awareness analogically, effectively reversing the usual reading of Genesis 1:26. This conception supports radical monotheism while rejecting kabbalistic reifications: notions such as *tzimtzum* and the *sephirot* are interpreted as metaphors rather than as ontological entities that would compromise divine unity.

The author distinguishes between miracles that are conceivable, such as creation itself or a limited sea-crossing event, and those that are physically impossible, such as a global Flood or literal Babel. This distinction reinforces the importance of separating *pshat* from conjectural *midrash* and of giving empirical evidence priority over faith-alone assertions.

Judaism remains central as a source of identity and communal cohesion. The Torah's aggadah is understood as parabolic literature whose non-literal

interpretation does not affect halakhah. Likewise, *emet* need not mean literal factuality; Psalm 23, for example, remains spiritually true despite its metaphorical language. Revelation is therefore understood as mediated through tradition rather than through direct divine dictation. In this framework, the Documentary Hypothesis (*J*, *E*, *P*, *D*) points to human authorship without negating religious significance.

Overall Message

The Torah's factual errors reflect ancient human guesswork rather than divine omniscience. Yet when read as parable, these narratives continue to convey enduring lessons about vice and destruction, human unity, liberation, and moral aspiration—fully compatible with evolution, archaeology, and historical inquiry.

Science must judge matters of fact, while spirituality flourishes once released from the burden of defending empirically untenable claims. Rational believers, the author argues, can fully embrace evidence without abandoning God, Torah, or Eretz Yisrael. Materialists, for their part, must still confront the philosophical reality of the soul.

This vision of *Madaa ve-Torah* seeks to liberate Judaism for modernity, ensuring the continued vitality and ethical force of the tradition in an age shaped by science and reason.

2. THE WORLD'S CREATION

Cosmology, broadly conceived, is the study of the physical universe and comprises cosmogony, cosmography, and cosmic dynamics: accounts of cosmic origins, structure, and development, respectively. Biology, broadly conceived, is the study of life and comprises accounts of its origins and history, its structures, composition and functioning, and the diversity of its forms and their evolutionary relationships. These terms provide a broadly adequate conceptual partitioning of the subject matter, although each field contains additional specialized subdomains that are not explicitly distinguished within this framework.

There are many factual errors in the cosmology and biology of the book of Genesis (*Bereshith*) in the light of modern science and common sense. The Torah explicitly proposes a period of creation of the world lasting a mere six "days;" and this period is traditionally understood literally and placed, following a chronology decided by rabbis[2], at only 5,786 years ago — whereas physical cosmology has established that the universe has evolved from the Big Bang to its present state over approximately 13.8 billion years. Moreover, the order in which the world's physical features are presented in the Torah does not correspond to the order found by scientific means, and many crucial facts discovered by science are not mentioned in the Torah. Additionally, the Torah's knowledge of biology seems very limited in the light of modern science (evolutionary biology). The purpose of the present chapter is to compare and contrast these competing narratives.

1. Science's account of cosmic and biological evolution

There are many interesting and well-written books on the market summarizing for laypersons the findings and theses of contemporary science on cosmology and biology; there are also videos worth watching on these subjects. I am myself not an expert in these fields, but sufficiently well-read and knowledgeable to be able to research and present the essential facts in a useful way. The following is a brief history of the universe and of life.

2 See https://en.wikipedia.org/wiki/Seder_Olam_Rabbah.

The universe apparently began about **13.8 billion years ago** in the event known as the Big Bang, when space, time, matter, and energy emerged from an extremely hot, dense state. **During the first fractions of a second**, fundamental forces separated and elementary particles formed. **Within minutes**, protons and neutrons combined to create the nuclei of hydrogen and helium. However, the universe remained opaque for hundreds of thousands of years.

About **380,000 years** after the Big Bang, temperatures had fallen enough for electrons to bind to nuclei, forming neutral atoms. This allowed **light** to travel freely for the first time — an event called recombination, whose relic radiation is observed today as the cosmic microwave background.

For tens of millions of years afterward, the universe entered a 'cosmic dark age,' until gravity caused clouds of gas to collapse into the **first stars**, which ignited around **100–200 million years** after the Big Bang. These early stars forged heavier elements in their cores and spread them through supernova explosions, enabling later generations of stars and planets. **Galaxies** assembled over the next several billion years.

Our own Sun formed **about 4.6 billion years ago**, from a cloud enriched by earlier stellar deaths. Soon after, **Earth** condensed **about 4.54 billion years ago**, and a giant impact likely produced **the Moon around 4.5 billion years ago**. Early Earth was hostile, but **liquid water** appeared **within a few hundred million years**.

Life emerged surprisingly early. The first evidence of living organisms — simple **prokaryotes** (bacteria-like cells without nuclei) — dates to about **3.5–3.8 billion years ago**. For nearly two billion years, life remained microscopic. Around **2.4 billion years ago**, photosynthetic microbes triggered the **Great Oxygenation Event**, fundamentally altering Earth's atmosphere.

More complex **eukaryotic cells** (with nuclei and organelles) appeared around **2.0–1.8 billion years ago**, likely through symbiotic mergers between simpler cells. True **multicellular organisms** emerged roughly **600–800 million years ago**, followed by the **Cambrian Explosion (~541 million years ago)**, when most major animal body plans rapidly appeared.

Earth's history has been punctuated by at least **five major mass extinctions**, including the end-Permian event (~252 million years ago), which eliminated about 90% of species, and the end-Cretaceous extinction (~66 million years ago), famously ending the reign of the dinosaurs and allowing mammals to diversify.

Modern humans (*Homo sapiens*) arose in Africa **about 300,000 years ago**, **spreading globally over the past 60,000–70,000 years**. Compared with cosmic

timescales, human history occupies only the tiniest fraction of a second in the universe's lifetime.

Today, the universe continues to expand, driven in part by dark energy. From primordial particles to galaxies, from single-celled microbes to conscious beings, this 13.8-billion-year story reveals a continuous chain of natural processes — gravity, chemistry, evolution — gradually transforming a simple beginning into the richly structured cosmos we now observe.

Regarding **the Big Bang**, the following more technical clarifications should be noted.

The popular image of the Big Bang as the explosion of a primordial "ball" or "point" of energy is misleading. The term sometimes used for the earliest state, "singularity," does not denote a physical object, but a limit of our current theories, where quantities such as density and temperature become undefined because the known laws of physics break down. For this reason, scientists do not describe an actual point-like entity with definite dimensions; at that stage, the size and geometry of the universe remain open questions. It is also inaccurate to describe the initial state of the universe as "pure energy," since energy is not a substance but a property of physical systems. In modern cosmology, there is no assumption of a localized object existing in space and then exploding outward. Rather, the Big Bang refers to an early state of interacting quantum fields governed by quantum mechanics, in which matter and energy were not yet clearly distinguishable in the familiar particle-based sense, and in which the universe as a whole was extremely hot and dense. Space itself expanded from this condition; it is not that matter burst into pre-existing space, but that space itself evolved.

During the first fractions of a second after the Big Bang, the universe underwent a series of rapid physical transitions as it expanded and cooled. At extremely high energies, it is thought that the fundamental interactions of nature were unified; as the temperature fell, these interactions separated through successive symmetry-breaking processes into the distinct forces known today. In many models, gravity separates first, followed by the strong nuclear force, and later the electroweak interaction splits into the electromagnetic and weak nuclear forces. In parallel with this differentiation of forces, the basic constituents of matter emerged. The earliest state is often described as a quark–gluon plasma, in which quarks and gluons moved freely. As the universe cooled further, quarks combined to form hadrons, notably protons and neutrons. Slightly later, electrons, neutrinos, and other elementary particles became stable components of the cosmic plasma. These processes

established the fundamental particles and forces that would govern all subsequent physical evolution.

Light, that is, electromagnetic radiation, is associated with photons and is described in modern physics as having both wave-like and particle-like aspects—two complementary ways of referring to the same phenomenon. Such radiation is associated with the earliest phases of the universe's evolution, but it did not exist as a distinct, well-defined physical phenomenon from the outset. In the earliest fractions of a second, the fundamental interactions were not yet differentiated; only after the separation of forces — particularly around 10^{-12} seconds after the Big Bang, when the electroweak interaction split into the electromagnetic and weak forces — did electromagnetic radiation become a distinct feature of the physical world in its current form, and photons became well-defined quanta of it. Even then, it could not propagate freely, since it was constantly scattered by charged particles in the dense primordial plasma. It is therefore not meaningful to speak of light as existing "at" the initial singularity, which represents not a describable physical state but a limit of our present theories.

2. The biblical six "days" of creation

Let us now examine the Torah narrative in Genesis 1–2:3 in the light of contemporary scientific findings and theories, without presuming it to be necessarily correct. Our aim, frankly, is to assess how far the Torah narrative is congruent with the current scientific account, taking the latter to be the more reliable. However, before one can venture such an assessment, one must first determine what the Torah text is actually saying — and what it is not saying — taking care to remain objective and impartial. This is clearly *a very important methodological posture*. To ensure an unprejudiced and unpolemical approach, one must begin by treating the text under scrutiny, if only hypothetically, as authored by an ordinary human being living in a particular place and time. If one treats the text from the outset as of Divine origin, and therefore not subject to any form of honest questioning or critique, it becomes impossible to penetrate, understand and evaluate it properly.

This approach, though respectful, admittedly differs from the traditional one. Traditional exegesis generally takes the Divine origin of the Torah as an axiom not open to critical scrutiny. Classical sources — including Talmudic, Midrashic, Geonic, medieval, and more recent orthodox commentators — raise and address many questions, but tend to avoid certain lines of inquiry and to reject certain answers as threatening to this basic premise. As a result, their conclusions may at

times appear foregone and insufficiently probing. The exegete intent on uncompromising inquiry must therefore remain independent of authoritative traditional interpretations of the text, so as to avoid confinement within inherited frameworks. If the text is indeed of Divine origin, that fact should emerge through examination; and likewise, if traditional interpretations are sound, this too should become evident.

1.1: In the beginning God created the heaven and the earth.

The scientific narrative makes no mention of God, simply because God is not a physical phenomenon that can be empirically detected or in any way inferred from empirical data. This, however, does not imply that the findings of science logically exclude the existence of God or His purported role as creator of the universe. The scientific narrative can begin only at the point at which matter (in whatever form, including 'pure energy') is already given; if nothing material precedes the Big Bang, science cannot investigate beyond that point. Scientists, like all human beings, can only speculate as to whether this matter had a beginning and, if so, how it came into being. The phrase "In the beginning," meaning in the first place or to begin with, thus seems an appropriate opening; but the claim that "God created" lies outside the purview of the physical sciences. This subject will be discussed in more detail in a later chapter; our concern in the present chapter is not theology but physical facts.

It is worth noting from the outset that, apart from the question of God's existence and creative role, the biblical and scientific accounts appear to share one important feature: both present the world as having emerged gradually rather than all at once, and thus both tacitly depend on the concept of time. The phrase "In the beginning" suggests time itself as the first creation. Similarly, Big Bang theorists maintain that time originates with that event. However, as we shall see, the two accounts differ significantly in other important respects. It should also be noted that the opening words of the Torah, *Bereshit bara Elohim…*, placing the verb *bara* (created) before the subject *Elohim* (God) does not presumably carry any special theological implication, since such order is commonplace in Biblical Hebrew syntax.

In interpreting biblical discourse, one must remain fully attentive to what is actually stated in the text and, where the intent is unclear, logically assess its possible meanings. Thus, for instance, there are two distinct ways of reading the clause "created heaven and earth" in the opening sentence. One is to take it as a brief introductory heading for the events that follow, which does not itself describe any stage of creation; this interpretation is supported by the use of a similar formula in Genesis 2:4, which may be understood as a closing statement for the creation narrative. The other is to take that clause as the initial stage of creation — the

creation first of heaven and then of earth — with the subsequent stages of creation set out in the succeeding verses. Accordingly, the sequence of events in verses 2–5 (first day), 6–8 (second day), and 14–19 (fourth day) may need to be interpreted differently in each case.

Note that my method in all exegesis, is to treat each verse — and each event mentioned within a verse — as a distinct step in the creation process, and to regard the order in which events are presented in the text as signifying a chronological sequence. This approach differs from that of many other interpreters, who focus principally on the sequence of "days" without paying close attention to the ordering of events within each "day," thereby allowing themselves to read into the text whatever sequence best fits their interpretation[3].

In Genesis 1, creation is expressed through several overlapping formulas: "created" (*bara*) in Genesis 1:1, 1:21, and 1:27; "made" (*'asah*) in Genesis 1:7, 1:16, 1:25, 1:26, 1:31, and 2:2; "let there be" (*yehi*) in Genesis 1:3, 1:6, and 1:14; "let the earth bring forth" (*tadshe ha'aretz* / *totse ha'aretz*) in Genesis 1:11 and 1:24; "let the waters swarm" (*yishretsu hamayim*) in Genesis 1:20; and the recurring introduction "And God said" (*wayyomer Elohim*) throughout the chapter, especially in Genesis 1:3, 1:6, 1:9, 1:11, 1:14, 1:20, 1:24, and 1:26. Although some commentators distinguish these formulas more sharply, noting for example that *bara* implies a uniquely Divine act of bringing something into existence, *asah* is a broader term for making or fashioning what already exists, and *yehi* marks creation by command rather than by direct action, for our present purposes these may be treated as broadly equivalent, all referring to God's creative activity.

What is meant by "the heaven(s) and the earth"? The Hebrew reads *et ha-shamayim ve-et ha-aretz*. The simplest interpretation is that the narrator is referring to the sky above his head and the ground beneath his feet — nothing more elaborate[4]. Modern readers tend to understand this phrase as a reference to the creation of the entire universe, and this is justified in a sense, since for the ancient narrator the sky above and the earth below constituted the totality of his experienced world. However, it does not follow that he had in mind the cosmos as understood today, extending from the Big Bang to the present, consists of billions of galaxies, each containing billions of stars, distributed throughout an expanding universe whose observable

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3 This tendency appears frequently in Nathan Aviezer's book *In the Beginning*, as will be shown in a later chapter.

4 The word *shamayim* has been interpreted (notably by Rashi) as *sham mayim*, meaning "there is water there," alluding to the "upper waters" in the cosmology of Genesis 1, and by others as an intensifier of *sham* ("there"), meaning "further out than there," by analogy with forms such as *pa'am* ("once") and *pa'amayim* ("twice").

portion — meaning the region from which light has had time to reach us — extends about 46.5 billion light-years in every direction from any observer, giving it a present diameter of roughly 93 billion light-years[5] (although the universe beyond this observable horizon may be much larger, or even infinite).

Note that *ha-olam* in the Torah carries a merely temporal sense of "eternity" (e.g. Genesis 9:16, 17:7, 21:33), and only later, in rabbinic Hebrew, came to denote "the world" in a spatial or cosmological sense. It follows that the narrator could not have intended to write "created *ha-olam*" in the sense in which the term is commonly understood today. Similarly, the modern Hebrew term *ha-yekum* ("the universe") is a relatively recent usage; in Biblical Hebrew its sense is closer to "that which stands/exists" or "all living existence" (cf. Genesis 7:4), and it does not correspond to the modern cosmological concept of the universe. It would therefore be anachronistic to read the phrase "created *ha-yekum*" into the text in its modern sense. Evidently, the Torah does not yet reflect a fully articulated concept of "world" or "universe" as understood in contemporary cosmology, and it would be methodologically questionable to project such a concept back into the text ex post facto.

> 2 Now the earth was unformed and void, and darkness was upon the face of the deep; and the spirit of God hovered over the face of the waters.

The first point to note here is the mention of "the earth," "(the) deep," and "the waters." If verse 1 is taken as introductory, then verse 2 informs us of the creation, in their initial forms, of the earth, the deep, and the waters. Alternatively, if verse 1 is taken as itself describing the first stages of creation, then verse 2 serves to inform us of an early condition of the Earth (following its creation in the preceding verse) and of the creation of (the) deep and the waters, in that order. Note that, while most translators render the Hebrew *tehom* as "the deep," the Hebrew text in fact contains no definite article (*ha-*).

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5 The observable universe is about 93 billion light-years across rather than the approximately 27.6 billion light-years expected from the 13.8-billion-year age of the universe alone, because space itself has expanded during the time that light has been traveling, causing the most distant observable galaxies to now be much farther away than they were when the light we observe today was emitted. The rate of expansion has not been constant, having slowed for billions of years under gravity before beginning to accelerate again about 5–6 billion years ago. A light-year is the distance light travels in one year, about 9.46 trillion kilometers. Thus, 93 billion light-years equals about 880,000,000,000,000,000,000,000 kilometers (about 880 sextillion kilometers), or, more conveniently, approximately 8.8×10^{23} km. For comparison, the average Earth–Sun distance is about 150 million km, so the diameter of the observable universe is roughly 5.9 quadrillion times that distance.

The characterization of the earth as "unformed and void" (*tohu va-vohu*) has been variously interpreted by commentators; but if it is referred literally to the planet Earth, it may be taken to simply mean that the earth's surface was desolate and uninhabited. Alternatively, if we opt for a less banal reading of verse 2, we might take it to suggest that the Earth was unconsolidated and depleted, that is, not yet fully formed and lacking some of the material it would in due course acquire. The statement that "darkness was upon the face of the deep" might, in either case, be understood to mean that the "deep" — the vast empty expanse surrounding the Earth — was still without luminous bodies such as the Sun, Moon, and stars, and was therefore dark; the "face of the deep" would then refer to the surface of the celestial vault in which these lights would later, on the fourth "day," be embedded[6]. As regards "the waters" (which are not yet defined here, but are clarified later in the narrative), the text as quoted suggests that they were already present, or came into being soon thereafter, with God "hovering above" their surface. The latter image makes sense, if we refer it to the "upper waters," which are themselves described as situated above the firmament/heavens (on the second "day").

Science could agree, to some extent, with the Torah's *tohu va-vohu* description. If this is taken to mean that planet Earth was, at some early stage, "unconsolidated and depleted," science may point to the time, about 4.5 billion years ago, when the early Earth is thought to have been struck by a Mars-sized protoplanet named Theia in scientific literature; some of its material merged with the Earth, while the rest — together with material ejected from the Earth — formed a debris disk that later coalesced into the Moon. If *tohu va-vohu* is interpreted as "desolate and uninhabited," science could instead refer to a later period in Earth's history, before the emergence of life (prior to about 3.5–4.0 billion years ago). However, science would not accept the claim that darkness ever surrounded the Earth, since the Sun and the stars existed long before its formation. Nor would it accept the "waters" posited in the text, for no such cosmic waters exist.

The preceding is a literal, earth-oriented interpretation of verse 2; however, most readers understand it in a more metaphorical and cosmological sense. This is achieved by interpreting *ha-aretz* as referring more generally to *ḥomer*, that is, matter as such, rather than specifically to the planet Earth. An early attempt in this direction is found in Maimonides (*Guide for the Perplexed*, II:19–30), who, in his

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6 The Greek Septuagint renders *tehom* as "the abyss." Rashi interprets this as "the waters that were on the earth," though this reading is problematic, since it leaves the reference to darkness unexplained and, in any case, the waters are mentioned separately immediately thereafter. A more plausible reading is that the deep is the primeval abyss in which the upper and lower waters are still undifferentiated, with the firmament later inserted between them.

effort to harmonize the Torah with Aristotelian doctrine, understands *ha-aretz* in verse 2 as referring to primordial, formless matter — that is, matter prior to the imposition of any form — a notion akin to the Aristotelian *hylē*. Later commentators develop this line of interpretation further and introduce the technical expression "*ḥomer ha-olam*." In that view, the statement that the earth was "unformed and void" could be taken to mean that the universe as a whole was at first (largely) unstructured and empty, or even chaotic and lacking distinct bodies. The reference to "darkness" would then be correspondingly more general, probably indicating that light was still not created (as implied by verse 3). But the reference to "the face of the waters" would remain rather mysterious in this context (at least until verse 6).

Science may be said to concur with this broader rereading of verse 2, whether intentional or not. When the Big Bang occurred, planet Earth did not appear at once. Subatomic particles such as protons and neutrons formed from quarks during the early cooling of the universe, within fractions of a second after the Big Bang. Low-mass atomic nuclei formed within the first few minutes, during the period of Big Bang nucleosynthesis. Neutral atoms, that is, atoms with equal numbers of protons and electrons, did not appear until much later, approximately 380,000 years after the Big Bang. The Earth itself came to be some 9.26 billion years after the Big Bang. Science would also agree that the universe remained dark for a long time. However, the early universe was dark not because light did not exist already, but because free electrons in the primordial plasma scattered photons so efficiently that radiation could not propagate freely until electrons and nuclei combined to form neutral atoms[7]. Moreover, for roughly 100 to 200 million years thereafter (and in some models extending up to 400 million years), there was a cosmic dark age until the first stars formed and began to emit light.

However, the truth is that there is no linguistic basis for interpreting *ha-aretz* as referring more abstractly to matter as such, or to matter in general: the Torah always

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7 One of the most important pieces of evidence in modern cosmology (discovered accidentally in 1965) is the cosmic microwave background (CMB), because it is essentially a direct, observable relic of the early universe — a 'snapshot' of the cosmos at about 380,000 years after the Big Bang, when electrons combined with protons to form neutral atoms, drastically reducing the scattering of photons by free electrons and thereby allowing the photons to decouple from matter and travel freely through space. This process is called recombination. The CMB does not originate at recombination, but marks the moment when the universe became transparent to radiation. The photons that now constitute the CMB, with a density of about 400 photons per cubic centimeter, were already present in the early universe; they are literally the oldest light in the universe. What we observe today as the CMB is this 'fossil radiation' or 'afterglow' of the early universe.

intends *ha-aretz* in a very concrete sense. It is also very doubtful that the author of a text as ancient as the Torah could have anticipated, even vaguely, the Big Bang scenario, which was first developed by George Gamow and collaborators in the late 1940s, and greatly developed since on the basis of numerous empirical observations using complex instruments. Of course, the text is traditionally regarded as Divinely inspired; but if neither a prophetic author (such as Moses) nor readers in pre-modern times would have been able to decipher its scientific articulation of empirical observations and theoretical concepts, it is unclear what purpose such communication could then possibly serve, unless its function were merely to impress. Thus, our above initial, literal and earth-oriented, reading appears more plausible.

And the scientific assessment of this literal reading is clearly negative. Planet Earth and water (H_2O) could not have come into being as early as the verse 2 narrative would imply, since the heavier elements of which they are composed first had to be forged through stellar fusion within earlier generations of stars, and only thereafter could such bodies form.

Earth's crust is dominated by eight key elements. Oxygen (symbol O, atomic number 8) constitutes ~46.6% of the crust by weight, followed by silicon (Si, 14) at ~27.7% and aluminum (Al, 13) at ~8.1%. Iron (Fe, 26) accounts for ~5.0%, calcium (Ca, 20) ~3.6%, sodium (Na, 11) ~2.8%, potassium (K, 19) ~2.6%, and magnesium (Mg, 12) ~2.1%. The remaining ~1.5% consists of other elements. These values are averaged estimates and vary slightly between continental and oceanic crust. Water consists of two hydrogen atoms bonded to one oxygen atom. The deeper Earth differs significantly in composition. The mantle consists mainly of oxygen, magnesium, silicon, and iron. The core is composed chiefly of iron and nickel (Ni, 28), with smaller amounts of lighter elements such as sulfur (S, 16) and oxygen.

Only three elements — hydrogen (H, 1), helium (He, 2), and trace amounts of lithium (Li, 3) — were formed in the immediate aftermath of the Big Bang, more precisely within the first 3 to 20 minutes. All heavier elements were subsequently forged in stars over billions of years and dispersed through space by stellar explosions, eventually contributing to the formation of planets such as Earth. A single massive star is sufficient to produce all elements up to iron through successive stages of nuclear fusion ($H \rightarrow He \rightarrow C \rightarrow O \rightarrow Si \rightarrow Fe$) during its lifetime, culminating in a supernova explosion. The principal elements of Earth's crust were all produced within this single-star nucleosynthetic, or stellar fusion, cycle. Elements heavier than iron, which also occur on Earth in smaller quantities,

require rapid neutron-capture processes, typically associated with supernovae or neutron-star mergers.

> 3 And God said: "Let there be light" And there was light. 4 And God saw the light, that it was good; and God divided the light from the darkness.

Whether verse 1 is read as introductory or as creative, verse 3 would seem to adopt a broader cosmological rather than an earth-oriented perspective, since it cannot plausibly be interpreted as referring to light reaching the Earth (created in v. 2) from the Sun, Moon, or stars, whose creation is recounted only later (in vv. 14–18), and includes the division of light from darkness. It therefore remains unclear why the narrative introduces light as such at precisely this stage, given the otherwise earth-centered character of the rest of the creation account. The explanation may well be *literary* rather than cosmological: because the narrator intended to divide the account of creation into apparently terrestrial "days," beginning in verse 5, it was necessary to introduce the phenomena of light and darkness at this juncture, well before the luminaries in the firmament are introduced.[8]

Although verse 3 is broadly congruent with the scientific narrative regarding light, it does not follow that its author was aware of the nature of light or of when and how it emerged in the unfolding universe. The insight that light was specifically created was, of course, an intellectual achievement of his, even if the concept of light as a distinct phenomenon was no doubt already common knowledge in his time and place; but there is no evidence of any deeper understanding. We must be careful not to read our own knowledge and ideas into the text, but rather stay attentive to what it actually says.

Nonetheless, from a modern perspective, verse 3 may be interpreted as referring to the emergence of light itself, in the form of a dense field of electromagnetic radiation composed of photons, within the first fractions of a second after the Big Bang. It should be stressed that this statement concerns light emerging *after* the Big

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[8] The mention of darkness in v. 2 may have motivated the narrator to insert the creation of light at precisely this point in the narrative. That vv. 3–5 constitute an interpolation seems evident from the fact that v. 2 ends with a mention of the waters, while v. 6 resumes with a mention of the waters. Similarly, v. 8, which marks the completion of the second "day," interrupts the continuity of the accounts concerning the lower waters in vv. 7 and 9. It is well to keep in mind that the verse numbering is not part of the original Torah text, but was added many centuries later. The division of the Hebrew Bible into verses developed within the Masoretic tradition, roughly between the sixth and tenth centuries CE, and was gradually standardized over time. (By contrast, the chapter divisions commonly used today originated in the medieval Christian tradition, in the late twelfth and early thirteenth centuries, and were subsequently adopted by Jewish scholars and printers for purposes of reference.)

Bang and cannot reasonably be identified, as one commentator[9] has attempted, with (to paraphrase him) a sort of ball of pure energy existing just prior to the Big Bang and then exploding, since (as noted earlier) the initial hot, dense state of the universe is not treated in current physical theory as a reifiable entity.

The separation of light from darkness (v. 4) could be roughly identified with the scientific account of the freeing of light when atoms started forming (about 380,000 years after the Big Bang), bearing in mind that, although light could now travel, there were not yet bright sources of light until stars began to form (several tens or a few hundreds of millions of years later). Alternatively, verse 3a might refer to initial formation of photons, verse 3b to the end of the opaque period (with the freeing of trapped photon, after about 380,000 years), and verse 4 to the end of the cosmic dark age (with the formation of luminous stars, roughly 100 to 400 million years later). In any case, "dividing the light from the darkness" should not be taken to imply that light and darkness were ever blended into a single substance; logically, darkness is simply the absence of light, not itself an entity comparable to light.

> 5 And God called the light Day, and the darkness He called Night. And there was evening and there was morning, **one day**.

This verse seems, prima facie, to refer to terrestrial days and nights, which have evenings and mornings. It could not refer to some form of light and darkness cycle in the wider cosmos, since no such phenomenon is known to exist. This reading is consistent with our previous suggestion in relation to verse 2 that the author[10] of Genesis 1 had in mind, principally, planet Earth rather than the universe as a whole. It seems that he had an earth-oriented and limited conception of the universe; meaning that to him the world was not much larger than what he could personally discern from where he stood (although he did supplement this with imaginative notions of upper and lower waters). From a modern standpoint, a 24-hour day, with roughly half the time dark (evening) and the other half light (morning), is understood as resulting from the rotation of the Earth on its axis facing the light of

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9 Namely, Nathan Aviezer in *In the Beginning* (pp. 15–16). See my remarks on this topic in chapter 9.2.

10 According to R. E. Friedman, based on 'higher criticism' analyses, the author of Genesis 1 and Genesis 2:1-3 was the priestly author labeled as P, estimated to have lived in the southern kingdom of Judea not long after the fall of the northern kingdom of Israel. Note the use of the name *Elohim* (God) throughout this portion; but this is just one among many indices.

the Sun[11]. We also know today that our planet (and indeed the solar system of which it is a small part) is a mere speck of dust in the vast expanse of the observable universe.

We cannot suppose offhand that the narrator did not intend the word "day" literally; although *yom* can denote more than a twenty-four-hour day, it does not naturally signify a cosmic era of billions of years. Had he meant a cosmic era of vast but unspecified duration, he would presumably have expressed this more explicitly, though it is not clear what word in his lexical repertoire would have served this function[12]. Nevertheless, if we opt to take the term "one day" as instead referring to a cosmic epoch, as verses 3–4 might suggest, the duration of "day one" of creation — understood as spanning from the Big Bang to the emergence of light from the midst of darkness — would be either about 380,000 years (up to the epoch when light could travel freely), or on the order of 100 to 400 million years (up to the formation of the first stars emitting light). In this perspective, a "day" cannot plausibly be understood as a single terrestrial day.[13]

> 6 And God said: "Let there be a firmament in the midst of the waters, and let it divide the waters from the waters." 7 And God made the firmament, and divided the waters which were under the firmament from the waters which were above the firmament; and it was so.

The author of verses 6–7 apparently conceived of the space surrounding the Earth as initially consisting of "waters" (*mayim*), which were divided into two separate

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11 The narrator presumably understood the terrestrial cycle of day and night as resulting from the Sun's motion around a flat Earth, a view widely held in the ancient Near East and the broader ancient world.

12 Possible biblical alternatives each denote extended or non-literal time in different ways, but none is an exact equivalent: *olam* implies indefiniteness or perpetuity, *dor* a generational span, while *tekufah*, which suggests a cycle or turning, is not a natural term for a cosmic era. No term in use in biblical times functions as a clear designation for a vast, unspecified cosmic period.

13 Commentators have asked why the cardinal expression "one day" is used rather than the ordinal "first day," as at the conclusion of the subsequent six days. The reason is often taken to be that the later days are numbered only in relation to preceding days, whereas the first stands initially alone, without reference to what follows. *Yom eḥad* thus appears to mean "a day" or "a single day" rather than "day one," which may suggest that the narrator conceived creation not as a pre-planned, sequential engineering project guided by a blueprint, but as a series of distinct gestures — more akin to an artist's evolving composition, a skillful improvisation. A further question concerns the use of the definite article: why are the first five days not preceded by "the," whereas the final two are. One possible explanation is that the sixth day, as the completion of creation, retrospectively marks the close of a defined series. Once the sixth day is grammatically marked as definitive, the seventh day must likewise be determined as its culmination.

layers by the interposition of a "firmament" (*raqiaʿ*) between them. The "waters" had already been created in verse 2, where they are first mentioned. The "firmament," which is identified with "heaven" in verse 8, was either created in verse 1 (if that verse is read as creative rather than introductory) or else not until verse 6. In the former case, verses 6–7 may be understood as describing the pre-existing firmament being inserted between the upper and lower waters created subsequently in verse 2. In the latter case, since the firmament comes into being only after the Earth and the waters, it must be understood as being created directly between the upper and lower waters through the command "let there be." The term "firmament" presumably refers to the physical sky and the celestial bodies visible in it, although these are described as created only later, in verses 14–18. The "waters" mentioned here, and earlier in verse 2, are not defined, and it is not immediately clear what the term is intended to denote. However, the "waters under and above the firmament" of Genesis 1:7 are poetically reactivated in Genesis 7:11, which states that "all the fountains of the great deep were broken up, and the windows of heaven were opened" in connection with the Flood. From that narrative, one may infer that the author imagined water reservoirs (of unspecified size) deep under the Earth's ground and high above its sky.

The Genesis 7:11 account suggests that the putative "lower waters" do not originate merely from surface waters such as oceans, seas, lakes, rivers, or subsurface aquifers, but from a deeper source. In a spherical Earth model, this would correspond, if at all, to waters conceived as lying beneath the Earth's crust within a spherical interior structure; whereas in a flat-earth cosmography[14], they would lie beneath the Earth as a whole, understood as a flat layer. Additionally, the Genesis 1:7 account suggests that the putative "upper waters" are situated *above* the firmament, and not merely *within* it, as would be the case with a vast atmospheric or cloud-like phenomenon visible from the Earth[15]. The firmament is thus presented as located between these two sets of waters and appears to function as a dividing structure within space itself, implying a relatively confined cosmological interval rather than the totality of outer space. Clearly, this narrative is not fully in accord with the modern scientific account. Neither a body of water suspended in outer

14 It is probable that the author conceived of the earth as a mostly flat surface, since nothing in the text suggests a spherical conception. Such a view became explicit only in Greek thought, beginning in the 6th century BCE, with Pythagoras, Anaxagoras, Aristotle, and later Eratosthenes commonly cited in its development.

15 Note that Nathan Aviezer (*op. cit.*, pp. 21–23) has suggested that the "upper waters" might refer to the ice found plentifully in comets and many planets and moons in our solar system. See my remarks on this topic in chapter 9.2.

space above the atmosphere nor a global reservoir of water beneath the Earth's crust (in a spherical model) or beneath the Earth as a whole (in a flat-earth model) finds support in current scientific understanding.

Verse 1 (if read as creative), together with verse 2, verse 5, and verses 6–7, all point to an earth-centered narrative, rather than a broadly cosmological creation one, on the part of the biblical author. The Earth is presented as the earliest creation, or perhaps the second after heaven; then come the "deep" of receptive space around the earth, followed by the "waters" above and below it; and finally, the "firmament" (also called "heaven") is either created or, if already created, shoved between these waters. This is not cosmology in the broad modern sense, but a markedly earth-bound and somewhat imaginative vision of events. Note also that the biblical author does not appear to have been aware that rain falls from clouds formed by the evaporation of water from seas, lakes, and rivers: while this hydrological cycle is common knowledge today, it does not seem to have been widely and fully understood in antiquity.

> 8 And God called the firmament Heaven. And there was evening and there was morning, a **second day**.

This verse identifies the firmament (*rakiaa*) with the heavens (*shamayim*)[16]. The preceding events are then said to constitute the "second day" of creation. From a scientific perspective, this "day" — lasting either from when light was freed or when stars were formed, until shortly after the Earth was formed — would have been roughly between 9.26 and 8.86 billion years long. Again, it certainly could not have been as brief as a single earthly day.

> 9 And God said: "Let the waters under the heaven be gathered together unto one place, and let the dry land appear." And it was so. 10 And God called the dry land Earth, and the gathering together of the waters called He Seas; and God saw that it was good.

Here (verses 9-10), the author's reference is clearly to the separation between the seas, lakes, and rivers on Earth (the lower waters, or more precisely those near the

16 With regard to Hebrew etymology: The word *mayim* ('water') derives from an ancient Proto-Semitic root meaning simply 'water' or 'liquid,' with cognates across Semitic languages; *raqiaʿ* ('firmament') comes from a root meaning 'to beat or hammer flat,' suggesting a solid, dome-like sky spread out over the Earth, closely matching ancient Near Eastern cosmology, in which the sky was imagined as a physical structure (like a vault) rather than empty space; and *shamayim* ('heavens') most likely derives from an ancient Semitic root meaning 'height' or 'upper region,' originally referring simply to the visible sky above the Earth, not to outer space or a metaphysical realm.

surface) from the dry lands on Earth. Clearly, we are now again very much focused on planet Earth. Note that the Torah text does not mention that Earth initially existed as a molten body before its surface cooled to form oceans and dry land. However, it is amazingly consistent with the scientific account in that it places the appearance of water before the emergence of dry land, describing the waters being gathered first and land appearing after.

According to current science, briefly put, Earth acquired much of its water during its formation about 4.54 billion years ago, with some additional delivery by water-rich asteroids[17]. Early extreme temperatures prevented liquid water from existing at the surface, keeping it as vapor or bound in minerals. As the planet cooled, water condensed into oceans by roughly 4.4 billion years ago, only a few hundred million years after Earth formed. Evidence from ancient zircon crystals suggests that the early Earth was largely ocean-dominated, possibly nearing a global ocean state, though transient volcanic islands may have existed. Stable continental crust emerged much later, becoming clearly established only after about 3.7–3.5 billion years ago. For hundreds of millions of years, therefore, Earth appears to have been covered predominantly by vast oceans, with little enduring dry land.

As regards the statement in verse 9 that the Earth's waters were "gathered together in one place," science might point to the period, around 335 million years ago, when there existed a great single landmass called Pangaea (from Greek, meaning "all land"), surrounded by a global ocean known as Panthalassa ("all sea"), although the expression "one place" does not quite fit this scenario, since it suggests a gathered body of water, such as an inland sea, rather than a superocean surrounding a supercontinent[18]. As far as geology can tell, there is no known period in Earth's history — including major ice ages — when all the planet's waters were literally gathered into a single localized place surrounded by land. The solution is simply to understand "in one place" as meaning "not in many places," that is, not in discrete inland bodies of water, but as a single encompassing body of water. The intent here is, in any case, presumably not fully literal; the verse need not be taken to exclude

17 Water-rich asteroids, especially carbonaceous chondrites, are thought to have contributed significantly to Earth's water, as their isotopic signatures (e.g. hydrogen ratios) more closely match those of Earth's oceans than do those of many comets.

18 Earlier possible candidates for a single major landmass include the hypothesized Archean supercontinents Vaalbara (c. 3.6–2.8 billion years ago) and Kenorland (c. 2.7–2.1 billion years ago). These, however, are much less certain than the later and well-established Pangaea, since their reconstruction depends on fragmentary and highly ancient geological evidence, and there remains considerable scholarly debate as to whether they constituted coherent supercontinents in the full sense.

smaller inland waters such as lakes and rivers, although the actual situation at the time concerned remains unknown.

> 11 And God said: "Let the earth put forth grass, herb yielding seed, and fruit-tree bearing fruit after its kind, wherein is the seed thereof, upon the earth." And it was so. 12 And the earth brought forth grass, herb yielding seed after its kind, and tree bearing fruit, wherein is the seed thereof, after its kind; and God saw that it was good.

Strictly speaking, Genesis 1:11 does not present a scientific botanical classification system in the modern sense. Its three terms — grass, herb yielding seed, and fruit tree bearing fruit with seed — are broad, everyday labels based on appearance and use, not on the actual biological structure, reproduction, or evolutionary relationships of plants. "Grass" is especially imprecise in this context, because in botany it refers to the grass family, *Poaceae*, while the verse seems to mean any low green vegetation. "Herb yielding seed" is also too vague to correspond to a modern plant group, since seed plants include many very different lineages. "Fruit tree" likewise is a practical, non-taxonomic category. The passage therefore does not distinguish between major plant groups such as mosses, ferns, gymnosperms, and flowering plants, and it leaves out much of the diversity that modern botany recognizes. Its scheme is best understood as a simple, pre-scientific way of describing visible kinds of vegetation, not as an accurate botanical account.

Major land-plant groups appear in a broad evolutionary sequence. The earliest land plants were non-vascular forms such as mosses, liverworts, and hornworts, with land plants dating to about 500 million years ago. Next came vascular plants, the first plants with internal transport tissue, around 430–420 million years ago. Seed plants appeared later, in the late Devonian, roughly 370–360 million years ago, followed much later by flowering plants, or angiosperms, around 140 million years ago. Grasses are a far later branch of the flowering plants, and many sources place their major diversification in the late Cretaceous to early Paleogene, roughly 70–50 million years ago. Seen through modern botany, the biblical categories can only be placed loosely in that evolutionary order. The oldest broad match is "herb yielding seed," which corresponds most nearly to the rise of seed plants about 370–360 million years ago; next comes "fruit tree bearing fruit with seed," which fits flowering plants and especially woody angiosperms, appearing around 140 million years ago; and last would be "grass," if taken in the modern botanical sense of true grasses, whose major diversification came much later, roughly 70–50 million years

ago. This sequence is only an approximation, because the biblical terms are everyday descriptive labels rather than precise botanical groups.[19]

Note that aquatic photosynthetic life is not mentioned in this verse, even though photosynthetic organisms existed in Earth's oceans as early as 3.5 billion years ago, long before true land plants evolved. Modern seagrasses appeared much later, about 100 million years ago, after some flowering-plant lineages returned to the sea from land. Also missing from the Torah account is the Great Oxygenation Event, around 2.45–2.1 billion years ago, triggered by photosynthetic cyanobacteria; during this period oxygen began accumulating in Earth's atmosphere for the first time, transforming the planet and contributing to major extinctions among anaerobic life, while also helping make complex aerobic life possible, including eventually humans. So, judged strictly by modern science, this verse is both inaccurate and incomplete as an account of Earth's biological history.

13 And there was evening and there was morning, a **third day**.

The "third day" stretched apparently from when the global ocean was formed, about 4.4 billion years ago, to when grasses evolved, about 70 million years ago. This means it lasted about 4.3 billion years. However, the Torah account does not report any of the events occurring between the formation of the global ocean (about 4.4 billion years ago) and the appearance of the first land plants (about 500 million years ago) — a blank period of almost 4 billion years. Note also, in passing, how the first three "days" of creation are of unequal duration, the first having up to 400 million years, the second around 9 billion years, and the third over 4 billion years.

> 14 And God said: "Let there be lights in the firmament of the heaven to divide the day from the night; and let them be for signs, and for seasons, and for days and years; 15 and let them be for lights in the firmament of the heaven to give light upon the earth." And it was so. 16 And God made the two great lights: the greater light to rule the day, and the lesser light to rule the night; and the stars. 17 And God set them in the firmament of the heaven to give light upon the earth, 18 and to rule over the day and over the night, and to divide the light from the darkness; and God saw that it was good.

In these five verses, the Sun, the Moon, and the stars are mentioned for the first time, seemingly created after "the firmament of the heavens" (created in v. 1 or 6,

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19 It seems that the narrator listed these three terms in that order because it intuitively seemed to him that grasses were the simplest, followed by more elaborate herbs yielding seed, and then by the larger fruit tree bearing fruit with seed. From a scientific perspective, this imagined sequence is incorrect, since grasses would belong last. The term includes both cultivated grasses such as wheat and rice and wild grasses found in meadows.

and until now empty of these celestial objects) and after planet Earth (created in v. 1 or 2, respectively either after or before the firmament) and its eventual vegetation (vv. 11-12), and they are portrayed merely as "lights" in the Earth's sky (seemingly newly embedded in the firmament). Notably, the Sun and Moon are mentioned first, in that order, before the stars. They are referred to as "the two great lights" because they both look larger and brighter on Earth than the surrounding stars, and then as the "greater" and "lesser" light, respectively, because the Sun typically appears larger and brighter than the Moon. This reflects a clearly terrestrial perspective. Note well that, though the stars are mentioned, there is no mention of the other planets and moons in our solar system and beyond. There is no recognition here that stars are vast stellar bodies, ranging in size from about one-tenth to several hundred times the Sun's radius, and that they are components of 100–200 billion immense galaxies, each containing from a few million to a few hundred billion stars[20]. Nor is it indicated that the Sun itself is a star, formed relatively late and not especially large in comparison to other stars, around which our slightly younger and much smaller planet Earth revolves, whereas the Moon is in turn a satellite of the Earth, slightly younger and much smaller than it[21].

The Sun, Moon, and stars are here presented as "lights," created "to divide the day from the night," "to be for signs, and for seasons, and for days and years," and "to give light upon the earth." The narrative thus concerns the purposes of their creation, namely their eventual utility to humankind (long before its own emergence), in marking daily and seasonal cycles and providing calendrical reference points, and possibly also "signs" of astrological significance. Science cannot directly contest such teleological explanations, since it has no access to God's mind and motives. It can only observe the sequence of physical events and estimate the intervals separating them. It may also point to the absence of physical descriptions that would indicate that the author of this text possessed a developed understanding of cosmic objects and processes; it cannot simply assume that he did. Science, moreover, rejects astrology outright as a demonstrably false system of explanation and prediction.

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20 The total number of stars in the observable universe is estimated at roughly 10^{22}–10^{24}, i.e. approximately 10 to 1,000 sextillion stars, depending on underlying assumptions. These figures are order-of-magnitude estimates rather than precise counts.

21 The Sun is about 109 times wider than Earth and about 400 times wider than the Moon, while Earth is about 3.7 times wider than the Moon. By volume, the Sun could contain about 1.3 million Earths, and Earth about 49 Moons. Remarkably, the Sun is also about 400 times farther from Earth than the Moon is, which makes the two appear almost exactly the same size in our sky and allows total solar eclipses to occur.

In the scientific narrative, the Big Bang occurred 13.8 billion years ago. The first stars began forming roughly 100–200 million years after the Big Bang, while the first galaxies appeared somewhat later, about 400 million years after it. Our galaxy, the Milky Way, began forming some 13 billion years ago and has been growing and evolving ever since. The Sun came into being about 4.57 billion years ago; the Earth formed about 4.54–4.56 billion years ago, and the Moon likely became its satellite within some tens of millions of years thereafter. Stars (including the Sun) emerged through the gravitational collapse of molecular clouds, whereas planets (including Earth) gradually coalesced from mineral and gaseous debris orbiting stars. The Moon most likely formed when a Mars-sized proto-planet orbiting the Sun became dynamically unstable and collided with the young Earth, mixing material from both bodies and ejecting debris that later coalesced into the Moon, while some of the impactor's material was incorporated into the Earth itself. During the immense span of time preceding the Earth's formation, stars passed through repeated evolutionary cycles of birth, ageing, and explosive death, thereby generating the heavy elements that ultimately made rocky planets like Earth possible. It should be noted that our planet could not have existed without these earlier stellar generations, which produced the elements found within it, including iron and silicon, as well as the oxygen that later combined to form water and the carbon essential for life.

19 And there was evening and there was morning, a **fourth day**.

A "fourth day," comprising the formation of stars, galaxies, Sun and Moon, would, according to science, span about 9 billion years. The Torah text presents this set of cosmic events as occurring after the appearance of grasses on planet Earth about 70 million years ago (in the latter part of the "third day," after the appearance of dry land) and before the creation of aquatic and aerial animals (on the fifth "day"). Clearly, the Torah not only presents Sun, Moon, and stars, in the wrong order of physical appearance, but also misplaces them chronologically relative to the Earth's appearance and much later terrestrial events. It cannot be argued, as some have tried, that this late introduction of Sun, Moon, and stars, is intended as a parenthesis in the narrative, because these cosmic events are explicitly presented as third and fourth in a sequence of "days." This problem might have been largely avoided if the events of the fourth day had been placed before those of the third day; but even in such case, the order of things would not have been quite what it should have been: namely: first many stars, then the Sun, then the Earth and Moon together (because they matured interactively), then vegetation, with the earliest land plants, seed-bearing plants, including herbs and trees, then flowering plants, and lastly grasses.

It is worth remarking that it is very surprising that the author of this creation account, living in an agricultural society, would have placed the creation of vegetation before that of the Sun. Anyone who had ever worked in a field would have known, without any advanced knowledge of agricultural science, that plants depend on sunlight for their growth. Today, of course, we understand precisely why: through photosynthesis, plants use light energy from the Sun to convert carbon dioxide and water into sugars, which provide them with the energy and building materials needed for growth. There is therefore good reason to question the sequence presented here. There is no conceivable material explication for it. There is only at best the literary possibility that the order of "days" three and four was inadvertently reversed at some early time in the transmission of the text, perhaps through a scribal error. This cannot readily be established, but it would resolve what otherwise appears to be a striking anomaly in the narrative.

> 20 And God said: "Let the waters swarm with swarms of living creatures, and let fowl fly above the earth in the open firmament of heaven." 21 And God created the great sea-monsters, and every living creature that creepeth, wherewith the waters swarmed, after its kind, and every winged fowl after its kind; and God saw that it was good. 22 And God blessed them, saying: "Be fruitful, and multiply, and fill the waters in the seas, and let fowl multiply in the earth." 23 And there was evening and there was morning, a **fifth day**. 24 And God said: "Let the earth bring forth the living creature after its kind, cattle, and creeping thing, and beast of the earth after its kind." And it was so. 25 And God made the beast of the earth after its kind, and the cattle after their kind, and every thing that creepeth upon the ground after its kind; and God saw that it was good.

It is best for us to examine this long passage, comprising verses 20-25, in one go, even though it deals with two "days" of creation, namely the fifth and part of the sixth. This narrative seems to refer to emergence of all creatures living in our planet's waters, and all those capable of flying, and thereafter all those living on land. First, note that the great diversity of forms of life in the waters, in the air, and on land, are lumped together indiscriminately, even though some vague examples are given for each group; this suggests that the author had limited experience of nature and little knowledge of taxonomy. According to modern science: today, animal life flourishes across Earth's waters, skies, and lands in immense diversity. In oceans, rivers, and lakes, it ranges from microscopic zooplankton and tiny invertebrates to fish, squid, and large marine mammals such as whales and dolphins. In the skies, airborne insects abound, together with birds and bats. On land, animals include wingless insects, arachnids, amphibians, reptiles, mammals,

birds, and humans, all occupying a wide range of ecological niches and forming complex, interconnected ecosystems.

Second, note that the author assumes that all animal life in the earth's waters and skies emerged at the one, earlier time (the fifth "day"), and all animal life on land came to be at one, later time (the sixth "day"). This is clearly erroneous. Current scientific estimates place the emergence of animals in Earth's waters, on land, and in the air at different times: simple marine animals over 600–700 million years ago; fish around 530 million years ago; amphibians around 370 million years ago; early terrestrial (wingless) insects around 410–400 million years ago, with flying insects appearing later around 350–330 million years ago; reptiles around 320 million years ago; mammals around 210 million years ago; birds around 150 million years ago; bats, which are mammals, around 50 million years ago; and humans only very recently, roughly 300,000 years ago. Note that marine life predates land and airborne life by hundreds of millions of years, and that airborne animals (flying insects, birds, and bats) evolved powered flight independently in different terrestrial lineages at different times, so that their respective timelines are nested within distinct evolutionary sequences on land.

Another point worth noting is that verses 24–25 mention "cattle" and "beast of the earth" separately, which gives the impression that domesticated and wild animals were created simultaneously as distinct categories; scientifically, however, most livestock species evolved over millions of years from wild ancestors and were domesticated and selectively bred by humans much later, mainly between about 11,000 and 4,000 years ago, when animal husbandry first developed in regions such as the Fertile Crescent, East Asia, and the Eurasian steppe.

The order and timing of the events alluded to in verses 20–25 are therefore highly confused and scientifically inaccurate. The fifth "day" appears to gather creatures whose origins range from more than 700 million years ago to about 50 million years ago, while the sixth "day" spans creatures originating from about 370 million years ago to the appearance of humans less than 1 million years ago; these chronological ranges overlap in complex ways, even though the biblical narrative presents them as successive. Amphibians, which first appeared around 370 million years ago, effectively belong to both "days." Moreover, if the fifth "day" includes literally all winged creatures, it must include flying insects (roughly 350–330 million years ago), birds (around 150 million years ago), and bats (around 50 million years ago); yet all these in fact emerged only *after* the terrestrial lineages from which they evolved — namely earlier wingless insect lineages or other terrestrial arthropod lineages (around 410–400 million years ago), early reptiles or reptile-like amniotes (around 320 million years ago), and early mammals or mammal-like ancestors

(around 210 million years ago), respectively — and thus properly belong within the broader sequence of land-animal evolution associated with the sixth "day." Thus, while the Torah is correct in placing marine creatures before terrestrial life, it is mistaken in placing airborne creatures before land creatures, and it also fails to recognize that amphibians occupy an intermediate position spanning both categories. The narrative further fails to mention the fact that countless animal species which once flourished are now extinct, including trilobites, ammonites, giant sea scorpions, armored placoderms, pterosaurs, giant prehistoric insects, non-avian dinosaurs, woolly mammoths, giant ground sloths, and the dodo, to name a few.

Additionally, the Torah narrative does not reflect the central process of biological evolution, by which living species emerged and diversified over deep time rather than appearing suddenly in fixed forms. Classical Darwinian accounts often emphasized gradual and continuous change. Contemporary evolutionary biology, while remaining rooted in the principle of descent with modification, has substantially expanded this framework through the modern synthesis and subsequent developments — including genetics, genetic drift, neutral evolution, developmental constraints, and genome-level processes — to explain the diversification of life as a historical process unfolding over millions of years through population-level mechanisms rather than through discrete acts of instantaneous creation. It is now recognized that evolutionary tempo varies across lineages, environments, and timescales, encompassing gradual change, comparatively rapid episodes of transformation, and extended periods of relative stasis, as reflected in the complementary models of phyletic gradualism and punctuated equilibrium. The fossil record, though necessarily fragmentary owing to incomplete preservation, remains crucial for reconstructing macroevolutionary patterns; it often documents species appearing abruptly on geological timescales (though not literally instantaneously), followed by long intervals of relative stability, with transitional forms frequently only sparsely preserved. Comparative genomics, moreover, provides robust and independent evidence for common descent through systematic similarities in DNA sequences across species, thereby reinforcing evolutionary relationships initially inferred from paleontology, comparative anatomy, and biogeography.

According to science, complex animal life appeared on Earth before land plants, with simple multicellular animals emerging around 600–700 million years ago, more complex bilaterian forms — animals with bilateral, left-right body symmetry, representing the main animal body plan that later gave rise to most modern animals — by about 555 million years ago, and the major diversification of animal body

plans and ecological expansion occurring during the Cambrian Explosion around 541 million years ago. The Cambrian Explosion was not exclusively a bilaterian event, however, since other early animal groups were also diversifying at the same time. It was a marine event: it took place underwater, in seas, and the animals involved fed on one another, on microbial mats, and on other marine life, rather than on underwater plants in the later modern sense. The Cambrian Explosion lasted tens of millions of years, with the major diversification of animal body plans occurring over roughly 20–25 million years. Its causes are still debated, though most scientists think it resulted from several interacting biological and environmental factors rather than a single trigger[22]. Land plants appeared later, around 500 million years ago.

As we have seen, in scientific chronology the fifth "day" would encompass creatures whose origins range from more than 700-600 million years ago to about 50 million years ago, while the sixth "day" would include creatures whose origins range from about 370 million years ago to the appearance of humans less than one million years ago. On that basis, the fifth and sixth "days" would overlap substantially rather than form two cleanly separated successive periods. The third "day" also creates a chronological difficulty, since it would begin with the first land plants, around 500 million years ago, while the animal "days" begin earlier and continue through later periods. Thus, the narrative's neat division of plant, sea-animal, air-animal, and land-animal creation does not match the actual evolutionary chronology, and these chronological inconsistencies are difficult to reconcile with a literal sequential reading of the text; this is worth emphasizing.

> 26 And God said: "Let us make man in our image, after our likeness; and let them have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth." 27 And God created man in His own image, in the image of God created He him; male and female created He them. 28 And God blessed them; and God said unto them: "Be fruitful, and multiply, and replenish the earth, and subdue it; and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that creepeth upon the earth." 29 And God said: "Behold, I have given you every herb yielding seed, which is upon the face of all the earth, and every tree, in

22 Andrew Parker's *In the Blink of an Eye: How Vision Sparked the Big Bang of Evolution* offers a stimulating and highly readable account of one proposed factor in the Cambrian Explosion, namely the evolution of vision; although Parker's hypothesis is not generally accepted as a complete explanation, the book remains, in my view, a valuable and thought-provoking introduction to the subject.

> which is the fruit of a tree yielding seed--to you it shall be for food; 30 and to every beast of the earth, and to every fowl of the air, and to every thing that creepeth upon the earth, wherein there is a living soul, I have given every green herb for food." And it was so. 31 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**.

Verses 26-31 narrate the creation of mankind, late in the "sixth day," following the creation of all (other) land-based animals. Man is thus presented as the most recent creature; and indeed, as the most impressive creature, having been formed "in the image of God." Much can be said about the latter statement, but since the present analysis is concerned only with physical issues, I will not comment on it here, though I will say a few words about it in a later chapter (8.2). As regards the age of mankind, this will also be dealt with in a later chapter. Suffices to say here that according to paleoanthropology, *Homo sapiens* emerged as a distinct species some 300,000 years ago, following millions of years of evolution from earlier hominin species. We must here ask the question — was the moment of the creation of man (and woman) the end of the "sixth day," or is this day ongoing till today and beyond? In other words, is the "sixth day" supposed to exclude or include the past 300,000 years? This brings us to the "seventh day."

> 2.1 And the heaven and the earth were finished, and all the host of them. 2 And on the **seventh day** God finished His work which He had made; and He rested on the seventh day from all His work which He had made. 3 And God blessed the seventh day, and hallowed it; because that in it He rested from all His work which God in creating had made.

Verses 1-3 of chapter 2 of Genesis clearly logically belong (and historically indeed did belong) with the narrative in chapter 1, since they refer to a "seventh day," in which God rested from His preceding bout of creative activity. But, from a secular, scientific perspective, nothing can be said regarding this additional "day," because no physical event is alleged by the Torah to have occurred during it. There is no textual claim that the physical world stopped moving in some significant way during that time, and no empirical evidence that it ever did. Thus, no period of past world history can be identified with this "day" of rest by God. Logically, if the "sixth day" ended precisely with the creation of mankind, or shortly after that, then the "seventh day" might be the past 300,000 years or so of history (until the present and onward); and we might say that God has abstained from 'universe creation' activities during that period, even if He has been engaged in other types of activity, such as 'universe management'. Alternatively, we might say that the "sixth day" has yet to end, and that God's "seventh day," His day of rest, is yet to come, when

history comes to an end; so that these three last verses are meant in the 'prophetic perfect' tense. A more mystical approach would be to regard God's "day" of rest from creation as occurring in some other dimension of time, rather than the timeline of our history; this would turn these three verses into a narrative of purely spiritual interest, making them significantly different in intent from the preceding more historically inclined verses.

3. Discussion and conclusions

In conclusion, the cosmology, biology, and human history presented in the Genesis 1 creation narrative are, from a scientific and scholarly perspective, questionable on several counts and, in some respects, demonstrably incorrect. The text reflects the discourse of a writer — or possibly a group or sequence of writers — in antiquity who lacked access to many facts now established through the observational, experimental, mathematical, and theoretical work of modern science and through historical scholarship, facts commonly known by most educated people today. In truth, the author or authors of the creation text cannot be said to have been particularly skilled in observing and explaining natural phenomena and historical events, even for the prescientific era in which he or they lived.

The focus of Genesis 1 is clearly Earth- and human-centered rather than cosmos- and life-centered, and its mode of expression is poetic and rudimentary rather than scientifically precise. People who view the Torah as a Divinely dictated or inspired document, which cannot contain even a single untruth, will of course find this frank conclusion frightening, unacceptable, and even heretic. But in my view, this finding does not make the Torah much less holy and valuable for Jews and others. Even if it is in small or large part or even entirely of human origin, the work of one or many human writer(s) — whether literally inspired or just humanly good and wise — it can retain the *inspiring, guiding, and unifying*, roles it has had for millennia.

Let us not forget that the main purpose of the first chapter of Genesis, and indeed of the whole Torah, is not provision of cosmological or biological information and explanation, but moral teaching and spiritual guidance. The Torah is not essentially concerned with scientific instruction, except for specific observations directly relevant to the practical applications of certain laws. It does make some historical claims, and many of its doctrines and commandments are connected to them; but many of its historical assertions are not indispensable to its religious message.

The first sentence of Genesis proclaims that *God exists* (since He is mentioned) and that *He is the one who created heaven and earth*. This is also the first sentence of the whole Torah document, and certainly one of its principal messages. That this

narrative was placed at the beginning of the Torah is not fortuitous: it was intended to justify in our eyes the spiritual source and authority of the whole of that document. Nevertheless, we are not told explicitly, at least not from the start, whether to consider the Torah as Divinely dictated or as merely Divinely inspired; either way, faith is required to accept its authority.

As regards heaven and earth, these terms could be taken to refer, more abstractly, to spirituality and materiality respectively, at least primarily, rather than to or as well as to concrete physical heavens and earth. That is, the first utterance of the Torah might signify that God created both spirituality and materiality, both a spiritual world, of which perhaps nothing more is said, and the material world comprising the heavens above and the Earth below, which the text seems to focus on.

We could similarly view verse 2, as descriptions of spiritual rather than material events. Perhaps the message here is that there was, initially in the newly emerging material world, a seeming lack of spiritual meaning (it being unformed, void, apparently dark), but this was true only superficially (the face of the deep, the face of the waters) because God was present spiritually hovering over it. In that poetic reading, verse 3 informs us that at some time, which might have come quite late (maybe even as late as when mankind emerged), God successfully introduced spiritual light; and verse 4 informs us that He divided this spiritual light, which He regarded as intrinsically good, from spiritual darkness (without, however, any mention of His abolishing the darkness, the relatively bad). Verse 5 may consequently simply, by means of metaphor, refer to the light as Day and the darkness as Night, to explain their relationship; and likewise, it may refer to this whole set of events as (cosmically) equivalent to one "day," or era, comprising as it did a spiritually dark period followed by a light one (presumably, into which we are moving, or in which we now already live). Thus, the whole first day could readily be read in purely spiritual terms, without any need to relate it to the underlying material events that modern cosmological science is concerned with. The spiritual events effectively 'hover above' the material ones, and ultimately give them their meaning, their reason for being.

We should also take note of the mention of beings with a "living soul" (Heb. *nefesh chaya*) in verse 30; in which category are apparently included mankind, and "every beast of the earth, and to every fowl of the air, and to every thing that creepeth upon the earth" (there is, however, inexplicably, no mention of sea creatures) — this too is a purely spiritual proposition (the term 'spiritual' meaning simply 'having to do

with the spirit, i.e. the soul'[23]); we shall say more about the soul in a later chapter. We should also notice verses 28-29, which are ethical propositions addressed to mankind; these as well qualify as spiritual statements since they are addressed to souls. It is debatable whether a similar proposition in verse 30, which seems to concern the other creatures just named can be called ethical, since it does not seem addressed to those creatures; but it could be viewed as so intended. These three verses do not directly concern biological science since they are not descriptions of the actual behavior of living organisms, but are rather prescriptions to living souls (although these do, or at least could, in due course influence or determine their behavior, and so become of interest to biology).

The next five "days" are more difficult to reread in purely spiritual terms, although the concluding expressions of satisfaction with His creations in v. 10 (third day), v. 12 (fourth day), v. 18 (fifth day), v. 25 and v. 31 (sixth day) are undoubtedly spiritual statements, since the term "good" used in them does not qualify as a material phenomenon. Interestingly, this term is not used regarding the second day[24]; and it is used twice regarding the sixth day, once for the land animals and once for mankind; the last use of the term, in the emphatic expression "very good," seems to apply both to mankind and to all creation, seemingly implying that mankind was the crowning achievement of the creative enterprise. All this projects the very spiritual image of God as a benevolent creator, intent on creating a world He can qualify as "good," though the precise meaning of this term is never given[25]. The seventh day, as we have seen, can only be interpreted spiritually, as Genesis 2:1-3 does not contain any statement about the material world. The significance of this last passage, about God's rest, only appears later in the Torah when Sabbath observance is prescribed to Jews; the Sabbath is then understood as an interval of spiritual rest from the whirl of everyday material concerns, similar to God's post-creation rest.

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23 N.B. I never use the term *spiritual* in the sense used in Spiritualism — the 19th-century religious movement characterized by medium-led séances and the belief that the living can communicate with the disembodied spirits of the dead, or ghosts. In my more philosophical usage, *spirit* simply means *soul*.

24 We can only speculate why. Maybe the second day was considered incomplete without the third day? But this idea is not very convincing, because if so, why would the two days not be counted as one day? The differences in content of the two days seem sufficient to justify counting two days. In that case, why would the second day not be characterized as independently good? Most probably this omission is simply due to a scribal error long ago.

25 It is philosophically noteworthy that the Torah repeatedly states "God saw that it was good," thereby presenting "goodness" as something that is objectively perceived, as it were, by God, rather than as something arbitrarily stipulated or decreed by Him.

Nevertheless, despite all these evident elements of spirituality in our text, we cannot dismiss the inextricable errors and striking omissions it contains with regard to material events, judged in light of what we know today thanks to modern scientific and historical research. We cannot simply ignore the vague description and dating of many of the events mentioned, nor the grossly incorrect sequencing of certain events, nor even the striking omission of some significant events. It would be intellectually dishonest to do so, and unworthy of respect. We must always face the relevant facts squarely and acknowledge them freely and fearlessly.

As regards the "days" of creation, these, as we have seen, would have to be understood as eras of very different duration, ranging from brief formative stages to periods of billions of years, and could not plausibly correspond to ordinary terrestrial days. There is no compelling reason, on either theological or rational grounds, to insist on a literal reading of six 24-hour periods. Why, after all, would God compress the entire process of creation into such an arbitrarily brief span of time? He would certainly have had the power to accomplish everything in an instant, let alone six terrestrial days — for Him, billions of years are no more than an instant — yet there is no suggestion that He was under any constraint or urgency. Moreover, since the cosmic and biological developments associated with each "day" unfold over vastly different timescales according to scientific understanding, the only way to preserve the idea that each day is of equal length, while acknowledging science, would be to propose that time itself runs at different speeds during each stage of creation. But this raises an obvious question: why would God introduce such a complication, varying the rate of time in this way, when no clear purpose or necessity for such a move can be discerned?[26]

As we remarked in our commentary on the creation of light, verses 3–5 are inconsistent with verses 14–18, which describe the creation of the sources of light on Earth, namely the Sun, Moon, and stars embedded in the firmament above it. The explanation we suggested was that the narrative of the creation of light was merely *a literary device* enabling the author to divide the creation account into terrestrial "days." This is an important insight, because it implies that the entire scheme of "days" dividing the creation narrative can and should be viewed as *an editorial overlay* — that is, a later textual layer composed either by the same author or by another, perhaps a redactor, for a specific purpose.

If we mentally remove this overlay — consisting of verses 1:3–5, 8, 13, 19, 23, 31, and 2:2–3 — we are left with the underlying cosmological narrative, comprising

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26 I am not here alluding to variations in time due to Relativity; that concept is clearly not relevant to the issue of the varying duration of the six "days" of creation.

the successive but undated creative acts of heaven and earth; the earth (at first *tohu vevohu*); the deep (*tehom*); the waters; the firmament (dividing the upper and lower waters); the dry land and the seas; grass, herbs yielding seed after their kinds, and fruit trees; the two great lights and the stars set in the firmament; aquatic and airborne creatures; terrestrial creatures; and finally man, after which God rested. The problems with the sequence of events we have previously identified, such as placing the creation of vegetation before that of the Sun, are not eliminated by removal of the overlay, but are perhaps made somewhat easier to manage. The motive for this *ex post facto* division of the creation narrative into "days" would seem to have been to introduce the Sabbath as the seventh "day," following the work of creation, thereby justifying the Jewish observance of Sabbath rest as an act of *imitatio Dei*.

Note in passing that besides Genesis 2:2–3, there are only two other passages in the Torah that relate the Sabbath to Creation, namely Exodus 20:11 and Exodus 31:17[27]. While Genesis 2:2–3 and Exodus 31:17 apparently reflect a common Priestly tradition, this does not imply that the two passages were written by the same individual or in the order presented in the final redaction of the Torah. Genesis 2:2–3 may have preceded or followed Exodus 31:17, even if both arose within the Priestly tradition. Ordinarily, one would assume that the 'editorial overlay' concerning the "days" of creation came first and that Exodus 31:17 reflects it; but it is equally possible that the 'editorial overlay' was written after Exodus 31:17 in order to explain or reinforce that passage. This does not affect the possibility that the 'editorial overlay' may have been written by the same or another individual as the writer(s) of the rest of the Genesis account of creation, as noted above. This is, of course, all speculative, but the hypothesis provides a possible explanation for the introduction of terrestrial "days" in the creation narrative.

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[27] According to R. E. Friedman's *The Bible With Sources Revealed*, Genesis 2:2–3 and Exodus 31:17 belong to the priestly Document P, while Exodus 20:11, found in the Fourth Commandment, belongs to the final redactor R. This suggests the possibility that the Creation–Sabbath connection was a feature of the Priestly tradition that was subsequently incorporated into Exodus 20:11 by R. Note that Genesis 2:2–3 and Exodus 31:17 both say that God ceased (*shavat*) from the work of creation, whereas Exodus 20:11 uses the verb *vayanach* ("rested"), which has a somewhat more anthropomorphic implication. Exodus 31:17, however, goes further by adding *vayinafash* ("was refreshed"), a verb from the same root as *nefesh*, suggesting the recovery of vitality or life-breath; this raises the possibility that this more anthropopathic addition was introduced into the verse by R. Note also that whereas Genesis 2:2–3 uses the word God (*Elohim*), the other two passages use the tetragrammaton (*YHVH*); this is consistent for P, who allows use of the latter name after its revelation to Moses in Exodus 3:15 and 6:2-3 (see Friedman, pp. 10–11).

It is important to emphasize that there is no mention, within the section under scrutiny here, of authorship or authority. We are not told who wrote it, and by what means he (or she or they) obtained and verified the information presented. We can reasonably assume that whoever wrote this text *sought to illustrate* God's purported creation of the world in some detail with the relatively limited arsenal of cosmological and biological knowledge available to him and his audience in his place and time. We can, in light of modern science's critique, argue that the history of the cosmos and of life that he adopted was not intended as Divinely revealed truth, but merely as a possible illustration (in Hebrew, *mashal*) — a conceivable scenario based on his own imagination or on ideas received from his entourage or culture. The biblical narrative seemed, it is true, credible enough to the many people who were influenced by it for millennia; but in the last few hundred years it has become progressively less credible, thanks to wide-ranging scientific research and countless discoveries made by courageous and well-meaning men and women. This led to the inevitable conclusion that it was, contrary to past assumption, *not* wholly Divinely revealed.

It remains logically true that the fact that the Torah document contains *some* factual errors does not suffice to prove that it is *all* in error. We cannot, here, generalize from 'some' to 'all' without case-by-case justification, for the simple reason that the Torah document evidently contains some factual truths. It may therefore still be supposed that the Torah's claims that God is, and is the world's creator, is true. There is admittedly no manifest proof of that; but it is certainly not completely refuted by current science, either. In truth, the said claims about God and creationism are logically compatible with *any possible*, past or future, content of science. Why? For the simple reason that, whatever science proposes as the most likely course of events, we can well say, without any contradiction, "OK, so *that's* how God did it!"

The proposition that God exists and that He created is simply logically impossible to refute by means of *any* description of physical things and events. To give an example, I have never understood why religious apologists, be they Jewish, Christian, or Islamic, get so worked up against 'the theory of evolution' of living species proposed by Darwin and his successors. This doctrine does not in fact contradict the hypothesis of God's existence and creation. All we need to say is that God created the world just as scientists, of any time and place, based on the empirical data at their disposal and their theorizing, describe it. There is absolutely no reason why God could not or would not create a world in which evolutionary processes play a major role. Note this well. It follows that the established scientific fact of evolution *does not* refute religious claims regarding God. What the scientific

account *does* refute is only the Genesis account, as above shown. To say that is not, however, a proof of God; it only serves to nullify an attempted disproof.

It is important to always remain intellectually honest, whatever one's preferences. I try to be both scientific and religious, but most of all I try to know *reality*; lucidity is a value I am utterly sure of. This is the one recipe for both true science and true religion. I see no value in fooling myself with fantasies, however satisfying they may superficially seem. Loyalty to both empirical facts and to logical reasoning — and keeping one's mind open, supple, and fair — are essential to judge any doctrine correctly and ensure ongoing contact with reality. Dogma, on either side, is just intellectual rigidity, bound to result in ignorance and foolishness.

In the last analysis, what have we lost in admitting that the story of creation proposed in Genesis chapter 1 is, by today's standards, mere fantasy in significant respects? Nothing much, that's for sure. The principal purpose of that narrative is to declare the existence of God and His creation of ourselves and of the world we inhabit. The precise steps through which God created the world we know, and ourselves in it, are in truth not very important to this act of faith. The essential message is spiritual and ethical. It could have been presented in a more abstract form, without proposing any concrete images; but this would likely have made it less attractive to some readers. An illustrative scenario was therefore suggested, in order to dramatize the main thesis and make it more accessible to a broader audience. Even if we now know that the scenario presented is largely unrealistic, its main spiritual and ethical message remains conceivable and significant. It is not discredited, but only needs to be recast in modern terms.

It is also worth observing that the universe disclosed by modern science — vast beyond ordinary comprehension, structured with astonishing complexity, comprising billions of galaxies each containing billions of stars, unfolding across immense reaches of space-time and governed by finely tuned physical laws, the whole unfolding over billions of years — greatly surpasses the comparatively compact and anthropocentric world reflected in Genesis. If the intention is to magnify Divine power and creative majesty, the modern cosmological vision arguably does so more powerfully, for it ascribes to the Creator a work of incomparably greater scope, depth, and intricacy.

4. The alleged date of the creation

At the time of writing this essay, the Hebrew calendar designates the current year as 5786 AM (Anno Mundi, 'year of the world'). This figure represents, according to rabbinic calculations, the number of years since the creation of Adam, taken to

mark the beginning of human history. In terms of the civil (Gregorian) calendar now in global use, this corresponds to 2025–26 CE (Common Era). Thus, in rabbinic chronology, creation is placed in 3761 BCE (Before the Common Era).

More precisely, the calendar begins on the first day of the month of Tishri, designated as Year 1 AM. This date is traditionally identified as the day Adam was created, and therefore the "sixth day" of creation in Genesis. It follows that the first day of creation occurred five days earlier, on the 25th of Elul. However, this initial act of creation is not assigned to a Year 0 or a negative year in the Hebrew calendar; rather, it is treated as lying outside the calendar's formal chronology, which is deliberately centered on humanity.

The following is a **neutral** description of the development of the Hebrew calendar by the rabbis:

The traditional Jewish calendar, known as *Anno Mundi* ('year of the world'), calculates the present year — 5786 AM — by constructing a continuous chronology beginning with the creation of Adam, derived primarily from biblical genealogies and later rabbinic historical traditions. The foundational framework comes from the *Seder Olam Rabbah*, a second-century CE rabbinic chronography traditionally attributed to Rabbi Yose ben Halafta. This work computes elapsed time by adding together the ages at fatherhood and lifespans of figures listed in Genesis, beginning with Adam and continuing through Noah, the patriarchs, and subsequent generations. According to this method, from the creation of Adam to the Flood (Genesis 5:3-32) spans 1,656 years; from the Flood to the birth of Abraham (Genesis 11:10-32) adds 292 years (1948 AM); from about Abraham's arrival in Canaan to the Exodus totals 430 years (2448 AM), following Exodus 12:40–41[28]; and from the Exodus to the construction of Solomon's Temple accounts for another 480 years, following 1 Kings 6:1. These figures are taken directly from the

28 Rabbinic tradition dates the Exodus of the Children of Israel from Egypt to 2448 AM. Since Jacob descended into Egypt at age 130 (Genesis 47:9) in 2238 AM, the actual sojourn in Egypt was only 210 years. To reconcile this with Genesis 15:13, which states: "Know of a surety that thy seed shall be a stranger in a land that is not theirs, and shall serve them; and they shall afflict them four hundred years," the rabbis begin the 400-year period with Isaac's birth in 2048 AM (when Abraham was 100), understanding "a land not theirs" to encompass both Canaan and Egypt. Likewise, Exodus 12:40–41 states: "Now the time that the children of Israel dwelt in Egypt was four hundred and thirty years," which the rabbis interpret as referring to the total sojourning of Abraham's descendants among strangers, not strictly time spent in Egypt. Counting 430 years backward from the Exodus would imply that Abraham was in Canaan in 2018 AM at age 70; but Genesis 12:4 states he arrived there at age 75 in 2023 AM. This five-year discrepancy is thus explained as the 430 years being a rounded or symbolic figure rather than a precise arithmetic interval.

Masoretic Hebrew text of the Tanakh and are treated as literal chronological data. The period of the First Temple is then reckoned as 410 years, as preserved in rabbinic tradition.

After the destruction of the First Temple, the chronology proceeds through the Babylonian exile and Second Temple period, again following the *Seder Olam*. The exile itself is counted as 70 years, in accordance with Jeremiah's prophecy. The Persian period is compressed in this tradition to 34 years total, covering the reigns of Persian kings from Cyrus to Darius, after which the Second Temple is said to have stood for 420 years. These figures yield a total of 3,828 years from creation to the destruction of the Second Temple in 70 CE. This date then becomes the primary historical anchor connecting biblical chronology to the Common Era. Medieval Jewish authorities, most notably Maimonides (Rabbi Moses ben Maimon) in his *Mishneh Torah* (Laws of Sanctification of the New Moon), formally codified this Anno Mundi system and its calculations, fixing the epoch of creation at 1 Tishri of 3761 BCE (proleptic Gregorian calendar), which is identified as the sixth day of creation — the day Adam was created. From this fixed epoch, years are counted forward continuously.

Once the Second Temple destruction is aligned with 70 CE, subsequent years are added straightforwardly using the established lunisolar Hebrew calendar, which employs a 19-year Metonic cycle with leap months to maintain alignment with the seasons. Each Rosh Hashanah marks the transition to a new Anno Mundi year. Thus, counting forward from the creation epoch in 3761 BCE through 70 CE (AM 3828) and onward through successive centuries yields the present year, 5786 AM, corresponding to 2025–26 CE. In this way, the modern Hebrew date is understood as the cumulative result of biblical genealogies, rabbinic historical reckoning as preserved in *Seder Olam Rabbah*, and later formalization by authorities such as Maimonides, producing an unbroken chronological sequence from Adam to the present.

Let us now take a more **critical** look at how this rabbinic chronology compares with the facts and ideas proposed by more recent archaeological and historical research:

When rabbinic Anno Mundi chronology is compared with archaeological and historical timelines from Persia, Egypt, and Mesopotamia, major discrepancies emerge, concentrated mainly in the Persian and Second Temple periods. Modern historians reconstruct Near Eastern chronology using inscriptions, administrative tablets, astronomical records, synchronisms between kingdoms, and radiocarbon dating, all of which form a mutually consistent framework across civilizations. By contrast, the rabbinic system preserved in *Seder Olam Rabbah* dramatically

compresses the Achaemenid Persian era. While mainstream scholarship dates Persian rule from Cyrus's conquest of Babylon in 539 BCE to Alexander's conquest in 332 BCE — about 207 years — *Seder Olam* assigns it only 34 years, **effectively omitting over 160 years of history and minimizing or excluding kings** such as Cambyses II, Xerxes I, and Artaxerxes I and II.

This compression directly affects the dating of the Second Temple. Archaeological and classical sources indicate the Temple was completed around 516 BCE and destroyed in 70 CE, giving it a lifespan of roughly 586 years, whereas rabbinic tradition assigns it only 420 years — a discrepancy closely matching the missing Persian centuries. Evidence for the longer chronology comes from Persian inscriptions, Babylonian astronomical diaries, Elephantine papyri, Greek historians, and synchronisms with Egyptian dynasties, all of which independently confirm extended Persian administration in Judea.

Additional tensions appear when biblical chronology is compared with Mesopotamian and Egyptian records, which show continuous advanced civilizations extending well beyond the dates implied by Anno Mundi. Egyptian king lists and radiocarbon-dated monuments, along with uninterrupted Mesopotamian cuneiform archives, document cultural continuity across periods treated as compressed in rabbinic reckoning. Modern historians therefore regard Anno Mundi as a theological chronology based on biblical genealogies rather than an archaeological reconstruction. The principal conflict lies with the Persian and Second Temple periods, where roughly 160–170 years documented by external evidence are absent from rabbinic calculation, making the traditional Jewish year correspondingly shorter than standard historical chronology.

In conclusion, the rabbinical estimates of the dates of creation of the world and of mankind are in error, not only in comparison with current cosmological and biological sciences, but also in comparison to the findings of scientific historians to date. This truth cannot be ignored or side-stepped; it must be consciously accepted and assimilated.

Note that traditional Christian and Islamic chronologies also proposed creation dates, including 4004 BCE in Anglican-Protestant tradition (based on Ussher's Annals); 5509 BCE in Eastern Orthodoxy (based on Septuagint); about 5500 BCE in Coptic and Ethiopian (Alexandrian calculations); and roughly 4000–6000 BCE in medieval Islamic historiography. And of course, all these were also quite mistaken.

It should be additionally remarked that the chronology of the early generations of mankind, based on Genesis 5 and 11, is seriously open to doubt, because the

longevity and fertility of the personalities listed in that chapter are historically and biologically incredible.

Genesis 5 and 11 report extraordinary lifespans for the patriarchs — Adam lived 930 years, Methuselah 969, Noah 950, and Shem 600 — with reproductive ages, for both their first son and subsequent children, extending into many hundreds of years. **Biologically, such longevity and late-age fatherhood are impossible.** Human lifespan is limited by cellular aging: telomere shortening, declining stem-cell regeneration, DNA mutations, protein misfolding, and organ deterioration, which together impose a hard ceiling near 120 years. Reproductive capacity is similarly constrained: women undergo menopause around age 50, and men's fertility declines after 60–70, making fatherhood at ages exceeding 100 incompatible with human biology. By comparison, modern humans live on average 73–75 years, with some reaching 100 or, very rarely, 120. Early humans of the Bronze Age (4000–6000 BCE) had life expectancies at birth of roughly 20–40 years, with some surviving into their 50s or 60s and only exceptionally to 70. Consequently, the extreme lifespans and late-age reproduction reported in Genesis — extending hundreds of years — have no basis in historical or evolutionary reality and reflect symbolic or theological intention rather than actual human biology.

There is no archaeological or physiological evidence supporting the chronological claims made in Genesis 5 and 11, and further on for the Patriarchs Abraham, Isaac, and Jacob. These figures belong to the genre of ancient legend and are comparable to longevity traditions found elsewhere in the ancient Near East, such as the Sumerian King List (which has some men living many thousands of years). Such texts do not objectively report facts, but are written to exalt persons their authors perceive as great by attributing superhuman powers to them. One could, on grounds of faith, claim these normally impossible lifespans and powers of late reproduction to be miraculous; however, the Torah itself does not present them as miracles. Rather, it implies that such extreme longevity and fertility were once normal but later (after the Patriarchs) became impossible.

Note that the begetting of Isaac by Abraham and Sarah at the respective ages of 100 and 90 is already presented as exceptional and miraculous; both are portrayed as being astonished by it, indicating that they themselves regarded it as contrary to normal biological expectations (Genesis 21:5). Isaac fathered Esau and Jacob when he was just 60 years old (Genesis 25:26); but Jacob was over 100 years old when he begat Benjamin (as can be roughly shown by calculations). Nonetheless, Abraham is claimed to have lived to the biologically unrealistic age of 175 (Genesis 25:7), Isaac to age 180 (Genesis 35:28), and Jacob to age 147 (Genesis 47:28).

If the chronological figures given in Genesis are of doubtful historicity, then their use in *Seder Olam* as the basis for the initial calendrical calculations could only yield erroneous results.

The interested reader can easily discover more on all the topics covered above; I have been satisfied here with presenting barebones information, sufficient to make my points.

5. The second creation story

There is apparently a second creation narrative in Genesis 2:4-23. Let us briefly look at it.

> **2:**4 These are the generations of the heaven and of the earth when they were created, in the day that Hashem God made earth and heaven. 5 No shrub of the field was yet in the earth, and no herb of the field had yet sprung up; for Hashem God had not caused it to rain upon the earth, and there was not a man to till the ground; 6 but there went up a mist from the earth, and watered the whole face of the ground. 7 Then Hashem God formed man of the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul…. 18 And Hashem God said: 'It is not good that the man should be alone; I will make him a help meet for him.' 19 And out of the ground Hashem God formed every beast of the field, and every fowl of the air; and brought them unto the man to see what he would call them; and whatsoever the man would call every living creature, that was to be the name thereof. 20 And the man gave names to all cattle, and to the fowl of the air, and to every beast of the field; but for Adam there was not found a help meet for him. 21 And Hashem God caused a deep sleep to fall upon the man, and he slept; and He took one of his ribs, and closed up the place with flesh instead thereof. 22 And the rib, which Hashem God had taken from the man, made He a woman, and brought her unto the man. 23 And the man said: 'This is now bone of my bones, and flesh of my flesh; she shall be called Woman, because she was taken out of Man.'

In this version, assuming all that is said is meant literally and to be taken in chronological sequence, Earth is apparently created first, before heaven (v. 4b)[29].

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29 Verse 4a states "These are the generations of the heaven and of the earth when they were created," placing heaven before earth. This seems to contradict verse 4b. R. E. Friedman explains this discrepancy neatly by claiming that 4a is an introductory interjection by the early redactor known as RJE, whereas 4b is the beginning of the narrative by source J.

Terrestrial plants were the life forms apparently created first, although the narrative focuses exclusively on agricultural produce — 'scrubs of the field' and 'herbs of the field' — which required rain and tilling of the ground by man (v. 5) and were apparently dormant initially until watered by a 'mist' (v. 6). Next, man was formed 'of the dust of the ground', and became 'a living soul' when God 'breathed into his nostrils the breath of life'. Next, apparently as aides to man (v. 18), animals (both 'every beast of the field, and every fowl of the air') were 'formed' (v. 19); these included 'cattle', as well as 'fowl of the air', and ' beast of the field' (v. 20). Lastly, seeing no animal was fit to support man, woman was 'made' by taking one of man's ribs and putting flesh in its stead (v. 21).

This order of creation differs significantly from that in Genesis 1, where heaven precedes Earth (v. 1), then come terrestrial plants (vv. 11-12), and aquatic and airborne animals (vv. 20-22), and land animals (vv. 24-25), then man and woman (vv. 26-27). Notice too that in the Genesis 2 narrative there is no mention of Sun, Moon, and stars, nor any of aquatic plants or animals; and no mention, either, of "days" of creation. Some commentators have suggested possible explanations for these differences; but they need not concern us in the present study, because our focus is on comparisons with the modern scientific narrative. The Genesis 1 narrative is a bit closer to modern science than that of Genesis 2.

In the scientific narrative, planet Earth is formed long after the heavens, i.e., the cosmic space beyond it containing stars and other celestial bodies; more precisely, Earth began forming some 9.2–9.3 billion years after the Big Bang, while the heavens were forming all during that time. As regards life on earth, briefly put, the sequence was: terrestrial plants, beginning around 500 million years ago; land animals, around 410–360 million years ago; then flying animals, much later, with flying insects appearing perhaps around 400 million years ago, birds around 200 million years ago, and bats around 50 million years ago; and only much later still, the earliest humans, around 300,000 years ago. In fact, wild animals long predate humans, even though some were later domesticated and modified through human selection and breeding. As regards human sexual differentiation, males and females did not emerge as isolated individuals but together, within population groups. Indeed, sexual reproduction and differentiation in living organisms arose long before the appearance of humans.

Sexual reproduction, which involves combining genetic material from two individuals, first appeared around 1.2–1.8 billion years ago in single-celled organisms. At first, these early organisms produced gametes (sex cells) that were all the same size and form. Later, two distinct types evolved: small, mobile sperm cells (male) and larger, nutrient-rich egg cells (female). In multicellular animals,

true male and female differentiation appeared around 600–700 million years ago, and by the time vertebrates evolved, the two sexes were clearly established. Humans and their hominid and hominin ancestors have always been sexually differentiated, with males and females appearing together in populations. Plants followed a similar but slightly later path, with separate male and female structures appearing in many species to allow cross-fertilization.

I should add a brief comment regarding the narrative about Adam naming all the animals, presumably the various species. Considering only the animals mentioned in v. 19 — "every beast of the field" and "every fowl of the air" — there are roughly 6,500 species of mammals and about 11,000 species of birds today. Clearly, the author of this verse could not have imagined how immense a task that would be for a single man. The significance of the story remains obscure. The simplest explanation is that it was intended to highlight human rational capabilities, since observing and naming things is a fundamental aspect of our conceptual cognitive processes. Some commentators have suggested that the labels used by Adam were not arbitrary, but somehow reflected the true, deep nature of the animals named. This claim is read into the text rather than stated in it. Jewish mystical tradition even developed a broad doctrine asserting a natural connection between Hebrew names (combinations of letters) and the things they denote; from the perspective of modern linguistics, however, this is fanciful. In fact, words are largely conventional signs — that is, they are arbitrary constructs grounded in social usage — and have no inherent bond to the nature of the things they signify, except in rare cases such as onomatopoeia (which are not what the mystics had in mind).

One final comment, in passing, concerns Genesis 3:1: "Now the serpent was more subtle than any beast of the field… And he said unto the woman…." Taken literally, this narrative would claim that at least some snakes are unusually intelligent and that one could speak and even spin fallacious arguments. Almost no one today would accept such a claim as fact. There is no empirical evidence to support it; the observed behavior of snakes, together with their lack of the anatomical structures required for articulated speech — including vocal folds and the necessary laryngeal and oral apparatus — not to mention a sufficiently complex brain for syntax and semantics, and for subtle but illogical judgments, clearly contradicts it. The idea of a snake behaving in the manner described is pure fantasy. The only plausible reading of this passage is that it was intended allegorically.

3. THE AGE OF MANKIND

1. The legend of Adam and Eve

According to modern science, as we have seen, the universe has existed for approximately 13.8 billion years since the Big Bang, and did not arise within six terrestrial days. The Earth began forming about 4.54 billion years ago. Life began to appear early in the planet's history, by 3.5–3.8 billion years ago, initially in simple cellular forms lacking nuclei. More complex cells, possessing nuclei and organelles, emerged roughly 1.8–2.0 billion years ago. Much later, 600-800 million years ago, multicellular organisms became widespread. A major diversification of life occurred during the Cambrian Explosion around 541 million years ago. Evolution thereafter continued through long periods of change punctuated by five major mass extinctions. The most recent of these, approximately 66 million years ago, did not initiate mammals but enabled their extensive diversification by eliminating the non-avian dinosaurs. From this evolutionary history, our own species, *Homo sapiens*, ultimately emerged in Africa around 300,000 years ago, gradually acquiring its modern anatomical form before spreading across the globe over the past 60,000–70,000 years.

Thus, science teaches us, there never was a first couple like the biblical Adam and Eve appearing suddenly on the world stage 5,786 years ago. There are many scientific reasons why the Adam and Eve story about the beginning of mankind cannot be true. The biblical claim that humanity is descended from a single couple (Adam and Eve) about 5,786 years ago is scientifically (mainly from the point of view of genetics) incredible, indeed impossible.

Modern genetics makes the idea that all humanity descends from a single couple living about 5,786 years ago scientifically untenable. Human genomes reveal far greater diversity than two founders could generate in roughly 231 generations (~25-year generations), even allowing for maximum recombination and mutation rates. Each human carries 46 chromosomes arranged in 23 pairs, inherited one chromosome of each pair from each parent. During the formation of sperm and eggs, these chromosomes undergo recombination, producing mosaics of maternal and paternal DNA and generating enormous diversity every generation. However, recombination only reshuffles existing variants; new genetic variants arise slowly through mutation (~50–100 per generation), and 5,786 years is far too short to

accumulate the millions of single-nucleotide polymorphisms (SNPs) observed across the human genome.

If all modern humans descended from just two individuals, genomes today would show unmistakable signatures of such an extreme bottleneck: very low genetic diversity, long stretches of identical DNA from inbreeding, high prevalence of recessive disorders, and reduced variation in key systems such as immunity. None of this is observed. Instead, humans display high heterozygosity, thousands of variants at many loci — especially in immune genes — and short shared DNA segments indicative of long-term recombination in large populations. Population genetic models (coalescent theory), allele-frequency distributions, and linkage disequilibrium decay, all converge on the same conclusion: human genetic diversity could not have arisen from a single couple within a few thousand years. Some variants predate our species *Homo sapiens* itself, having been inherited from earlier populations — something impossible under a recent two-person founding scenario.

Mitochondrial DNA ('mtDNA Eve') and Y-chromosome ('Y Adam') studies are often misunderstood. These markers do not identify a first woman or man, but rather the most recent individuals whose maternal or paternal lineages survived to the present. They lived at different times — mtDNA Eve roughly 150,000–200,000 years ago, Y Adam roughly 200,000–300,000 years ago — and they did so among large African populations, not as a single couple. Fossil and archaeological records align with these genetic clocks, placing anatomically modern humans in Africa around 300,000 years ago.

A two-person origin would also require generations of close inbreeding, rapidly producing severe genetic disease and reduced viability. Yet global human populations do not show such catastrophic patterns. Even extreme ancient bottlenecks, such as those around 900,000 and 70,000 years ago, only reduced effective population sizes to thousands, never to two individuals. Small founder populations on isolated islands, like Tasmania or Polynesia, illustrate how vulnerable tiny groups are to extinction; humans recovered only gradually over thousands of years.

In sum, the richness, structure, and distribution of modern human genomes — combined with fossil and archaeological evidence — decisively rule out descent from a single couple a half-dozen millennia ago. Humanity's origin necessarily lies in large, interconnected ancestral populations, not in two isolated founders. Any literal reading of Adam and Eve as sole progenitors is therefore *mathematically, biologically, and genetically impossible*.

I draw the attention of those who continue to doubt the scientific narrative to the existence of prehistoric cave art: this offers striking evidence of humanity's deep

antiquity. The oldest known figurative paintings, recently discovered in Sulawesi, Indonesia, are dated to approximately **67,800 years ago**, depicting humans and animals. Comparable works appear across the world, including Chauvet Cave in France (about 30–36,000 years old), Lascaux (some 17,000 years old), and Altamira in Spain (about 14,000–20,000 years old). These global examples show that anatomically modern humans were present long before recorded history, and capable of symbolic thought and cultural expression, far earlier than any timeline of only a few thousand years would allow. The age of prehistoric cave art is determined by using techniques such as uranium-thorium dating of mineral deposits over or under the paintings, radiocarbon dating of organic pigments or associated materials, and stratigraphic context from archaeological layers, providing reliable estimates for works like the Sulawesi paintings.

The Torah relates that all of mankind is descended from a single couple, Adam and Eve, created 5,786 years ago from today. They are said to have had three sons, named Cain, Abel and Seth; but though there is no mention of daughters, there must have been one or more girl(s) for further reproduction to naturally occur. This would imply that humanity is the product of massive inbreeding, starting with at least one act of incest. It is well known from experience that this would quickly lead to very serious diseases and rapid extinction, and science today is able to explain exactly why. Humanity must therefore have in fact existed far longer than the Torah claims, and indeed must have been the result of a long process of evolution. All claims to the contrary are mere fantasy and cannot be honestly upheld.

Rabbinic Judaism affirms that all humanity descends from a single original human. This is stated explicitly in Mishnah Sanhedrin 4:5, which teaches that Adam was created alone to demonstrate the unity and equal worth of all people. No classical rabbinic source proposes the existence of pre-Adamite humans; all humanity is understood to descend from Adam and Eve. People attached to the Torah can continue to do so only if they look upon this narrative as intended not literally, but symbolically. Its essence is the statement that *God created mankind* (and perhaps also that *mankind is one*). There is no justification in hanging on, at all costs, to the literal Torah narrative; doing so does more harm than good to the credibility of the Torah and of its adherents. Its teaching is essentially spiritual and ethical, not about material things, events, or processes. The latter are incidental to its messages, and its messages can well remain standing without them.

We can no longer claim that God created mankind through a single founding couple, but we can reasonably claim that God did this *through* the long process of evolution identified by modern biology. Fundamentalists desperately, against all

evidence, oppose the scientific theory of evolution thinking that this attitude is necessary to maintain their faith, indeed that it is a virtue in God's eyes. But that is logically erroneous: there is no inevitable contradiction between belief in God and acceptance of biological evolution. The only contradiction is more precisely between the literal reading of the Torah narrative and the facts of evolution. The way out of the conundrum is simply to view the Torah narrative in this case (as in many others) as merely figurative, reflecting the state of human knowledge (i.e. the natural ignorance of people) at the time it was written. One must remain confident that God loves truth above all; that He does not want us to cling to false narratives.

Although the Torah's claim that mankind descends from a single couple is denied by science, its implied claim that mankind is one family is confirmed by science: From a genealogical perspective, all humans living today are part of a single interconnected family tree: if traced far enough back, everyone's ancestral lines eventually intersect. However, this does not mean humanity has descended from a single couple. Genetic evidence shows that, at whatever point in the deep past, modern humans arose from large, interbreeding populations numbering thousands, not two individuals. Over generations, these populations spread, mixed, and overlapped, so while we are all related genealogically, the rich genetic diversity observed today reflects hundreds of thousands of years of evolution across large, widespread populations.

As regards the genealogies of mankind from Adam to Noah mentioned in Genesis 4-5[30], having established on genetic and historical grounds that Adam and Eve cannot possibly be the sole original human beings, we must logically say that their alleged descendants were not the ancestors of all subsequent humanity. Just as Adam and Eve may have been a historical, distinguished couple in a wider human population, so, some or all of their alleged descendants might also have been real people; but it remains possible that some or all of the afore-mentioned individuals were legendary.[31]

Note in passing that another story in the Torah to be similarly evaluated by means of modern genetics and historical studies is the claim that 4,130 years ago there was a worldwide flood that killed off all of humanity (which had developed in the 1656 years since creation) except for Noah and his three sons and their spouses. This

30 Note in passing that R. E. Friedman attributes these genealogies to J, RJE, and other sources.

31 But in any case, their alleged late fertility and great longevity (in the hundreds of years) cannot be true according to science.

narrative too does not stand up to scrutiny. More will be said on this topic in the chapter on the Flood.

2. The true age of humanity

We know today that humanity is approximately 100,000–300,000 years old, as established by both genetic and paleoanthropological evidence. Let us briefly consider the latter line of scientific findings.

Prior to the emergence of our species, *Homo sapiens*, Africa was inhabited by multiple populations of large-brained Middle Pleistocene *Homo*, often classified as *H. heidelbergensis* or *H. rhodesiensis*, themselves descended from earlier *H. erectus/ergaster*. Genetic evidence indicates that these African populations diverged from Eurasian lineages ancestral to Neanderthals and Denisovans roughly 550–765 thousand years ago. Within Africa, however, substantial population structures persisted for hundreds of thousands of years, accompanied by intermittent gene flow among regions. In other words, these early human groups were not a single uniform population but were divided into several partly separated regional populations that remained genetically distinct for long periods, although occasional interbreeding between them still occurred. Together, fossil and genetic data indicate that Homo sapiens emerged gradually as an evolutionary lineage rather than as a sharply delimited species arising at a single moment or place.

Fossil evidence places anatomically recognizable *Homo sapiens* in Africa by approximately 300,000 years ago, notably at Jebel Irhoud in Morocco. Early representatives display a mosaic of features, combining largely modern facial morphology with more robust and elongated cranial vaults. Later East African fossils, including Omo Kibish (~195,000 years ago) and Herto (~160,000 years ago), document increasing anatomical refinement toward recent human proportions. The commonly invoked distinction between “archaic” and “anatomically modern” *H. sapiens*, often situated around 150,000 years ago, therefore represents a heuristic classification rather than a discrete biological boundary. Anatomical and behavioral modernity accumulated progressively across interconnected African populations over tens of thousands of years.

Apologists for the Torah-based rabbinical claim that mankind is (today, at time of writing) 5,786 years old might respond to the science-based information that it is some 300,000 years old by suggesting that perhaps Adam and Eve were a historical couple in the Middle East who, though they lived among many other people, were the ancestors of all people surviving today, all other potential ancestors and their descendants having in fact not survived. This, they would argue, could reconcile

the conflicting claims of Torah and Science. But such reconciliation is not possible for genetic reasons.

Modern population genetics overwhelmingly contradicts the hypothesis that all humans descend from a single founding couple living a few thousand years ago. The constraint is not ideological but mathematical and empirical. Human mutation rates are directly measured and well understood. Each generation introduces roughly 60–100 new mutations per individual, corresponding to a per-base mutation rate near 1×10^{-8} per generation. Over approximately 6,000 years (≈240 generations), these rates are far too low to generate the vast genetic diversity observed in modern humans.

Contemporary human populations exhibit millions of single-nucleotide polymorphisms (SNPs) and extensive allelic variation across the genome. Many loci, particularly highly polymorphic systems such as the HLA (human leukocyte antigen) genes, display hundreds to thousands of alleles. Such diversity cannot arise from two genomes within a few thousand years under realistic mutation dynamics. This is a straightforward consequence of mutation mathematics. Furthermore, an extreme population bottleneck to two individuals would leave unmistakable genomic signatures, including severe loss of alleles, widespread homozygosity, long runs of identical DNA, and strong linkage disequilibrium. These patterns are not observed. Instead, human genomes preserve deep, ancient variation incompatible with a recent pair bottleneck.

Coalescent modeling, which reconstructs ancestral population dynamics from genomic variation, consistently indicates long-term human effective population sizes (Ne) on the order of several thousand individuals over much of the last million years. While precise estimates vary, even highly conservative values exclude Ne = 2 by orders of magnitude. Additional independent evidence reinforces this conclusion. Non-African populations carry Neanderthal DNA (~1–2%), and some populations retain Denisovan ancestry. These introgression events require large, structured ancestral populations and cannot be reconciled with a recent two-person origin. Likewise, mitochondrial DNA (‘mtDNA Eve’) and Y-chromosome (‘Y Adam’) most recent common ancestors represent lineage survival within large populations, not solitary progenitors.

Apologists have attempted to argue against the above-mentioned facts and arguments, but failed miserably as the following counterarguments make clear. Apologetic responses to the genetic evidence typically invoke several strategies, none of which withstand scientific scrutiny. Appeals to Divinely created ‘initial diversity’ abandon genetic mechanisms altogether and conflict with the observed mutation-derived structure and coalescent histories of human variation. Claims of

drastically elevated past mutation rates would entail catastrophic genetic load and population collapse, rendering long-term viability impossible. Proposals that Adam and Eve were recent ancestors among many contemporaries fail because, if only their descendants survived, modern genomes would display clear bottleneck signatures — extreme homozygosity and severe allele loss — which are in fact absent. Arguments citing uncertainty in effective population size estimates are likewise unpersuasive, since even the most conservative values remain incompatible with a bottleneck to two individuals. Collectively, these counterarguments either suspend empirical genetics or generate predictions contradicted by genomic data.

3. About Y chromosomes and mitochondrial DNA

Let us now go a bit deeper into some of the issues raised in the above remarks.

We shall start with Y chromosomes. All human males carry a Y chromosome, which is transmitted exclusively from father to son, since females lack this chromosome. Because the Y chromosome undergoes little recombination — not pairing with the X chromosome across most of its length during meiosis — it is inherited largely unchanged along the paternal line, with variation arising primarily through rare point mutations (roughly 1–2 per generation). These mutations act as a molecular clock, allowing reconstruction of paternal lineages deep into prehistory.

Genetic analyses based on Y-chromosomal variation converge on the figure known as '**Y-chromosomal Adam**,' defined not as the first man, but as the most recent common ancestor (MRCA) whose Y lineage is shared by all living men. He is estimated to have lived in Africa approximately 200,000–300,000 years ago within a large interbreeding population. This framework reconciles both continuity and diversity: although no two men today possess identical Y chromosomes — differences of hundreds of mutations separating even relatively close lineages — phylogenetic trees derived from global sequencing demonstrate that all modern Y chromosomes ultimately branch from this ancestral lineage via continuous father-to-son transmission. Much like surnames diverging gradually while retaining a common origin, contemporary Y lineages may differ profoundly yet still converge upon shared ancestral markers.

At fertilization, a Y-bearing sperm contributes its DNA to the zygote without modification beyond ordinary replication errors, thereby preserving the patrilineal signal. Crucially, this genetic structure excludes the possibility of a recent Adam living only a few thousand years ago: a bottleneck of such extreme recency would

produce vastly less Y-chromosomal diversity than observed. Mutation-rate calibrations, lineage coalescence models, and genome-wide variation collectively indicate that human paternal lineages arose within large populations over hundreds of thousands of years, rendering literalist chronologies genetically untenable absent recourse to untestable assumptions such as radically accelerated mutation rates.

One may naturally wonder, in light of the preceding discussion of the biblical Adam, why Jewish males — including Levites and Cohanim — do not exhibit uniform Y-chromosome lineages consistent with traditional claims of descent from Jacob, Levi, and Aaron, respectively. The following explanation addresses this question.

The absence of Y-chromosome uniformity among Jewish males, including those identifying as Cohanim and Levites, is fully consistent with well-established principles of population genetics and does not constitute a scientific anomaly. Over the course of roughly three millennia, even extremely low rates of lineage disruption — arising from non-paternity events, adoption, conversion, demographic bottlenecks, and the ordinary extinction of male lines — inevitably generate multiple surviving paternal lineages. Genetic inheritance follows strict biological pathways, whereas religious lineage systems describe social and legal descent categories that are transmitted through cultural continuity rather than molecular verification. These two frameworks, though related, are not expected to coincide perfectly.

Moreover, genealogical ancestry expands rapidly across generations, while genetic inheritance is selectively filtered: individuals may descend from historically significant ancestors without retaining their specific Y chromosome. In long-lived populations, most paternal lines naturally disappear, while others expand through drift and founder effects. The observed genetic patterns within Jewish populations — including both paternal diversity and partial clustering among many Cohanim — are therefore best understood as the predictable outcome of normal demographic and evolutionary processes acting over long timescales. Such diversity neither undermines shared ancient ancestry nor contradicts historical continuity; rather, it reflects the universal dynamics governing all human populations.

Genetic drift refers to random fluctuations in gene frequencies arising from chance reproductive outcomes, an effect that is particularly pronounced in small or historically bottlenecked populations. Founder effects represent a specific instance of drift occurring when a population — such as distinct Jewish communities — is established by a limited number of individuals, whose genetic variants become disproportionately represented in subsequent generations. Over long timescales, these processes can substantially reshape genetic patterns, amplifying certain

paternal lineages while eliminating others, independent of natural selection. Such mechanisms are fundamental to understanding why Jewish males, including Levites and Cohanim, exhibit both genetic diversity and lineage clustering rather than uniform Y-chromosome inheritance.

Let us now examine mitochondrial DNA. All human cells, male or female, contain mitochondria, which house mitochondrial DNA (mtDNA). However, only mothers transmit this DNA to their children, because sperm mitochondria are effectively excluded at fertilization. Consequently, mtDNA is inherited exclusively through the maternal line: both sons and daughters receive their mother's mitochondria, but only daughters pass them on to the next generation. Unlike nuclear DNA, mtDNA does not undergo recombination and changes primarily through the gradual accumulation of mutations, enabling maternal lineages to be traced with unusual clarity.

Over long timescales, most maternal lineages naturally become extinct, as some women leave no daughters while others' lineages expand through genetic drift. The so-called '**Mitochondrial Eve**' — the most recent woman from whom all humans living today inherited their mtDNA — is estimated to have lived in Africa roughly 150,000–200,000 years ago. She was not the only woman of her time, but simply the individual whose maternal lineage alone persisted to the present. Accordingly, the existence of such a common ancestor reflects statistical lineage survival rather than a population collapse or singular origin.

These processes, together with founder effects and demographic bottlenecks, explain why human populations — including historically small and structured groups such as Jewish communities — exhibit patterned maternal diversity rather than uniform inheritance.

Lastly, it is important to understand **the difference between genetic lineage and genealogical ancestry**: genetic lineage (Y or mtDNA) tracks a single line of descent, whereas genealogical ancestry tracks all your ancestors across every lineage. For example, if you are a male, you inherit only one Y chromosome, but have hundreds of male ancestors in the past 10 generations; whether you are a male or female, you inherit only one mtDNA lineage, yet descend from hundreds of female ancestors in the same period. Consequently, most of your ancestors *leave no trace* in your Y or mtDNA, even though they contributed to your autosomal genome.

This leads to the so-called 'maternal/paternal lineage paradox': the most recent common paternal ancestor (Y-chromosomal Adam, ~200–300k years ago) and the most recent common maternal ancestor (Mitochondrial Eve, ~150–200k years ago) *lived at different times*, yet both were part of large, genetically diverse populations.

They were not the only humans alive, nor the only ancestors of modern people; rather, their lineages alone happened to survive in an unbroken male or female line to the present. The difference in their dates reflects stochastic lineage extinction, which is entirely normal in population genetics. Meanwhile, all other ancestors contributed to the nuclear genome, explaining how humans can retain massive genetic diversity even when a single Y and a single mtDNA lineage remain. This demonstrates that lineage convergence in uniparental markers is fully compatible with large populations, high diversity, and complex genealogical ancestry.

4. World population size

Scientific estimates of world population are very different from those claimed or implied in the Torah:

Scientific estimates of world population provide a stark contrast to literal biblical chronologies. Around the alleged time of creation (≈3760 BCE), the global population was roughly 7–14 million people. By the time traditionally associated with the Flood (≈2105 BCE), it had grown to approximately 27–50 million, and shortly thereafter, at the period linked to the Tower of Babel (≈1764 BCE), the world hosted around 30–50 million individuals. This implies an average annual growth rate of only about **0.1–0.12% per year** — extremely slow by modern standards, consistent with pre-industrial, subsistence agricultural societies. These figures show that human populations were already widely dispersed and genetically diverse, making the idea of a single founding couple or family as the sole source of all humans impossible.

Using the exponential growth formula $P_t = P_0 \cdot (1 + r)^t$, one can calculate the rates required to reach today's ~8 billion humans from tiny ancestral groups. If humanity began with a single couple around 3760 BCE (the traditional date of Adam and Eve), the population would have needed to grow at roughly **0.38% per year** over 5,786 years, which, assuming a generation length of 25 years, corresponds to about 231 generations with each family averaging 2.2 children. Similarly, if the world were repopulated from Noah's family of eight around 2100 BCE, the required growth rate rises slightly to about **0.51% per year** over 4,100 years, corresponding to roughly 164 generations with 2.3 children per family. While these numbers appear modest, they are biologically implausible: such tiny populations would be extremely vulnerable to disease, mortality, or environmental stresses, and even perfect reproduction at these rates could not generate the immense genetic diversity observed today.

For comparison, pre-industrial human population growth rate averaged **0.4–0.6% a year**, but this applied to millions of people, not a handful of founders. Modern post-industrial growth rates of **1–2% per year**, fueled by medicine, sanitation, and agriculture, allow rapid expansion but could still never generate billions of descendants from a single family within a few millennia. Coupled with genetic evidence showing that all humans descend from thousands of breeders over hundreds of thousands of years, these calculations make it clear that literal interpretations of Adam, Eve, or Noah and his family (i.e. including his wife and sons' wives) as sole progenitors of humanity are mathematically and biologically untenable.

Over the last 300,000 years, humans have experienced several notable **population bottlenecks**, though they were at no point reduced to a single couple or family. Around 70,000 years ago, the super-eruption of the Toba volcano in Sumatra — one of the largest volcanic eruptions known in the last two million years — likely caused a sharp decline in effective population size, reducing it to roughly 1,000–10,000 individuals for a few thousand years due to global climate stress. During Out-of-Africa migrations (~60–50,000 years ago), small founder populations left Africa and settled Eurasia, creating regional bottlenecks of a few thousand individuals that later expanded through dispersal and interbreeding. Similarly, isolated island populations, such as in Tasmania or Polynesia, were sometimes reduced to just hundreds of individuals, yet recovered locally over generations.

Recovery after these bottlenecks occurred gradually through population growth, gene flow among groups, and adaptive innovations such as improved tools and agriculture. Even during the most severe bottlenecks, humans remained a population thousands-strong, not a single pair or family, and recovery was gradual. These events shaped genetic diversity but are fully compatible with evolution from large populations and cannot support literal readings of Adam, Eve, or Noah and his family, as the sole progenitors of humanity.

4. A WORLDWIDE FLOOD

According to the book of **Genesis chapters 6-8**, a great flood (*mabul*) covered planet Earth about 1,656 years after the creation of the world (according to traditional Jewish chronology), meaning roughly 4,130 years ago (c. 2104 BCE). We shall here analyze this claim and assess its credibility objectively.

1. Flooding and drainage

The Flood story is open to much criticism as regards its *physical* assumptions and assertions. The following is a selective list of Genesis 7-8 verses relevant to the discussion of flooding and drainage rates.

> **7:**4 For yet seven days, and *I will cause it to rain upon the earth forty days and forty nights; and every living substance that I have made will I blot out from off the face of the earth*.' 5 And Noah did according unto all that Hashem commanded him. 6 And Noah was six hundred years old when the flood of waters was upon the earth. 7 And Noah went in, and his sons, and his wife, and his sons' wives with him, into the ark, because of the waters of the flood. 8 Of clean beasts, and of beasts that are not clean, and of fowls, and of every thing that creepeth upon the ground, 9 there went in two and two unto Noah into the ark, male and female, as God commanded Noah. 10 And it came to pass after the seven days, that the waters of the flood were upon the earth. 11 *In the six hundredth year of Noah's life, in the second month, on the seventeenth day of the month, on the same day* were all the fountains of the great deep broken up, and the windows of heaven were opened. 12 And the rain was upon the earth *forty days and forty nights*…. 17 And the flood was forty days upon the earth; and the waters increased, and bore up the ark, and it was lifted up above the earth. 18 And the waters prevailed, and increased greatly upon the earth; and the ark went upon the face of the waters. 19 And the waters prevailed exceedingly upon the earth; and *all the high mountains that were under the whole heaven were covered*. 20 *Fifteen cubits upward did the waters prevail; and the mountains were covered*…. 24 *And the waters prevailed upon the earth a hundred and fifty days*.

> **8:**1 And God remembered Noah, and every living thing, and all the cattle that were with him in the ark; and God made a wind to pass over the earth, *and the waters assuaged*; 2 *the fountains also of the deep and the windows of heaven were stopped, and the rain from heaven was restrained*. 3 And *the waters returned from off the earth continually*; and *after the end of a hundred and fifty days the waters decreased*. 4 *And the ark rested in the seventh month, on the seventeenth day of the month, upon the mountains of Ararat*. 5 And *the waters decreased continually until the tenth month; in the tenth month, on the first day of the month, were the tops of the mountains seen*. 6 And it came to pass *at the end of forty days*, that Noah opened the window of the ark which he had made. 7 And he sent forth a raven, and it went forth to and fro, until the waters were dried up from off the earth. 8 And he sent forth a dove from him, to see if the waters were abated from off the face of the ground. 9 But the dove found no rest for the sole of her foot, and she returned unto him to the ark, for the waters were on the face of the whole earth; and he put forth his hand, and took her, and brought her in unto him into the ark. 10 And *he stayed yet other seven days*; and again he sent forth the dove out of the ark. 11 And the dove came in to him at eventide; and lo in her mouth an olive-leaf freshly plucked; so Noah knew that *the waters were abated from off the earth*. 12 And *he stayed yet other seven days*; and sent forth the dove; and she returned not again unto him any more. 13 And it came to pass *in the six hundred and first year, in the first month, the first day of the month, the waters were dried up from off the earth*; and Noah removed the covering of the ark, and looked, and behold, the face of the ground was dried. 14 And *in the second month, on the seven and twentieth day of the month, was the earth dry*.

This text is a bit ambiguous regarding the exact chronology of the Flood, which is why different interpretations have been proposed for it by different commentators, Jewish and non-Jewish. But I will not, here, attempt to present and discuss them all, because *the precise scenario chosen does not radically affect the arguments* I am about to propose. I will simply resort to the traditional narrative as much as possible, though I may have to interject certain comments of my own where gaps are apparent.

According to the traditional rabbinic chronology for Noah's flood[32], the timeline starts on Cheshvan 17 (Noah's year 600, when ark closed and rain begins) and unfolds **over exactly 365 days (one solar year)** to Cheshvan 27 (his year 601, when ark emptied) using the lengths for the months given in the Hebrew lunar calendar[33]. It goes as follows: Cheshvan 17 to Kislev 26 marks 40 days of rain; Kislev 27 to Iyyar 29 counts the 150 days of waters 'prevailing'; Sivan 1 to Sivan 16 adds 16 days, until the ark settles on Mt. Ararat on Sivan 17; Sivan 17 to Tammuz 29 totals another 43 days before peaks break the surface on Av 1; Av 1 to Elul 9 spans 39 days before the raven is sent out on Elul 10; Elul 10 to Elul 16 is 7 days before the first dove sent on Elul 17; Elul 17 to Elul 23 adds 7 days for the second dove, which returns with olive leaf; on Elul 24 the third dove is sent out but does not return, count 6 days to Elul 29; on Tishrei 1, Noah removed the ark cover and saw that the water had subsided (though presumably the ground was still soggy); finally, from Tishrei 1 to Cheshvan 27 count 57 days until the ground fully dries and the people come out of the ark (40+150+16+43+39+7+7+6+57=365 total).

The traditional reading of Genesis 6-8 is, then, that the global flood event consisted of a period of **40 days** (7:12) during which waters rose to a height of 15 cubits above the highest mountain in the world (7:20). This was followed by a period of **150 days** during which the waters "*prevailed upon the earth*" (7:24); I take this to mean that the floodwaters neither increased nor decreased during that period[34]. Then, "*after the end of a hundred and fifty days the waters decreased*" (8:3b); I take this to mean that the floodwaters started receding precisely as of the end of that period[35]. Thereafter, over a period of **175 days**, the waters abated and the earth dried

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32 See https://www.chabad.org/library/article_cdo/aid/246609/jewish/The-Story-of-Noah-and-the-ark-in-the-Bible.htm#footnote7a246609. This is a mainstream, orthodox account, mainly based on Rashi's commentary.

33 365 days = 354 days (Cheshvan 17 to Cheshvan 16) plus 11 days (from Cheshvan 17 to Cheshvan 27). I gather that the rabbis viewed the year 1656 as a leap year in a Hebrew calendar, which means that it would have many more days than here calculated. There is obviously a contradiction, but I need not bother here to look into it, because whatever the answer to that question, the conclusions of my analysis would remain essentially the same.

34 Ovadia Sforno (Italy, c. 1470-1550 CE) likewise interprets the 150 days as a period of static high-water level worldwide before recession (explaining this phenomenon as due to the continuing pressure of the waters from the deep while the waters from above had ceased to rain).

35 Note that these suppositions concerning the 150 days are open to doubt because the first part of v. 8:3 states: "And the waters returned from off the earth continually." However, that statement could be viewed as merely anticipating what happens after the 150 days, since the second

up. Three distinct phases of drainage are spelled out: from when the waters were at their highest level to until they dropped to the mountain tops (a descent of 15 cubits), viz. Sivan 1 to Tammuz 29 (**59 days**); then until the waters subsided, viz. Av 1 to Elul 29 (**59 days**); and finally, until the land was fully dry again, viz. Tishrei 1 to Cheshvan 27 (**57 days**).

The first of these drainage phases is punctuated by the landing of Noah's ark on Mt. Ararat on Sivan 17. Regarding this, the following should be understood: the keel (the bottom of the ark) rests on top of the mountain as of that day, but waters continue to surround the hull (the outer walls of the ark) to about the water line. The hull is 30 cubits high; but while the ark was afloat, about half of it was out of the water, and the rest was below (the exact draught depends on the weight of the cargo). So, the water is at a height of say 15 cubits (some suggest 11 cubits) above that mountain top when the ark comes to rest on it. From Sivan 1 to Sivan 16 (16 days), and then from Sivan 17 to Tammuz 29 (43 days), waters are receding, presumably at a constant rate (volume drained per day); so, about ¼ of those waters receded before the ark touched the mountain top, and about ¾ receded until the mountain tops became visible. However, since the earth is spherical, this does not mean that the same 1:3 proportions are applicable to the 15 cubits presumably traversed by the water level in that interval (contrary to what some commentators have assumed), because the volume of water changes. This said in passing, because for the purposes of the present analysis it is not very important — what counts is the total figure of 175 days of drainage.

Regarding the initial and final dryness of the land referred to in vv. 8:13-14, the text does not specify clearly the difference between these two degrees of dryness. I assume that at the earlier date (on Elul 29) the water is no longer above the earth, but the earth is still abnormally wet, while at the later date (on Cheshvan 27) the earth is back to normal. i.e. with its usual patches and flows of water. More important, it is unclear in the text whether these statements concerning the dryness of the land refer to conditions at the ark's high-altitude Ararat landing site (~5km elevation above sea level), or at the foothills of that mountain (still at ~1km above sea level), or on land at the global sea-level (0m). Even if Noah would not, from his remote mountain-top vantage point, be able to assess the situation accurately, the land at sea-level hypothesis seems to me the most logical and the one to adopt as otherwise the flood would not really have ended.

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part of v. 8:3 seems to imply that clearly. Interestingly, R. E. Friedman attributes the two parts of v. 8:3 to different authors (J and P); this would well explain the tension in that verse.

Let us now proceed with various **calculations and arguments**. The average radius of planet Earth is about 6,371 kilometers. To calculate the volume of a sphere, the formula is $V = \frac{4\pi r^3}{3}$, where r is the radius. Therefore, $V \approx 1{,}083{,}206{,}916{,}846\ \text{km}^3$ — that is, the volume of planet Earth is about **1,083.2 billion cubic kilometers**.[36]

According to vv. 7:19–20, the floodwaters rose to a height of 15 cubits above the highest mountains. A cubit is approximately 0.445 meters, so 15 cubits equal about **6.7 meters** above the highest mountains covered by the floodwaters. If we take this literally, the highest mountain on Earth is Mount Everest, which was at that time approximately 8,837 meters high above sea level (about 12 meters shorter than today). The floodwaters, having risen 6.7 meters above that, would therefore have reached roughly 8,844 kilometers above sea level. Adding this to Earth's said average radius, we obtain a radius of 6,380 kilometers. A sphere with this radius would have a volume of 1,087,800,000,000 km³ — that is, approximately **1,087.8 billion cubic kilometers**.

Subtracting the previously calculated volume of Earth at sea level yields a difference of about **4.6 billion cubic kilometers**. This figure represents *the additional volume of water required* to raise a global ocean to a level 6.7 meters above the summit of Mt. Everest. It being very unlikely that someone living in the Near or Middle East at the time the Genesis text was written would know about Mt. Everest, we might instead (for the sake of argument) interpret the term "*all the high mountains that were under the whole heaven*" (7:19) as referring more modestly to Mount Ararat, where Noah's ark finally landed (8:4), whose elevation is approximately 5,137 meters above sea level, then adding the same 6.7 meters gives a flood height of about 5,144 meters. Applying the preceding calculation yields an additional required water volume of approximately **2.6 billion cubic kilometers**. Volumes such as 4.6 or 2.6 billion cubic kilometers are very small compared with the total volume of the Earth (above mentioned), yet in absolute terms they are almost unimaginably large.

Note that the average daily rate of flooding (total volume divided by 40 days) for the Everest hypothesis would be approximately 115 million cubic kilometers per day, and for the Ararat hypothesis approximately 65 million cubic kilometers per day. These figures correspond to water rising by **roughly 225 meters per day and**

36 This calculation employs a simplifying spherical model of the Earth, treating the surface as uniform and disregarding continental elevations and displacement effects, approximations that do not materially affect the conclusion.

128 meters per day, respectively. Because the Earth is so large relative to these water volumes and depths, these rates remain essentially constant throughout the 40-day period.

To appreciate the scale implied by these figures, consider that if all of Earth's land ice were to melt, global sea levels would rise by only about **65–70 meters in total**, a tiny fraction of the 8.8- and 5.1- kilometer elevations of the said mountains. This estimate derives mainly from the Antarctic and Greenland ice sheets, with smaller contributions from mountain glaciers. Moreover, even under extreme natural conditions, such complete melting would require many centuries to millennia; it could not occur within a single year. Ice melt, therefore, could not plausibly have been the principal source of the biblical flood.

The total volume of water currently present on Earth, including oceans, ice, groundwater, lakes, rivers, and atmospheric moisture, is scientifically estimated at about **1.386 billion cubic kilometers**. ***The biblical flood would therefore have required vast quantities of additional water, piled atop existing waters.*** It could not be accounted for as drawn from waters already present on or above or below the earth. In the Everest scenario, this implies (as above shown) roughly **4.6 billion cubic kilometers** of extra water — more than **three times** (3.3) all the water presently on Earth. Even the Ararat scenario would require nearly **twice** (1.9) the planet's total water inventory. It is evident that the biblical narrative does not account for such physical considerations.

Genesis 7:11-12 reads: "*all the fountains of the great deep broken up, and the windows of heaven were opened. And the rain was upon the earth forty days and forty nights.*" Evidently, the author of these lines imagined that there were massive quantities of additional waters somehow stored deep below the surface of the earth and high above its atmosphere. But there are in fact no such water reserves to be found anywhere. Probably, too, the author imagined the earth as a flat surface, suspended in space between a heavenly domain and a subterranean domain. He did not think of it as a closed spherical ecosystem. He was not aware that rain is part of a natural *cycle* including evaporation of water from oceans, lakes, and rivers; the cooling and condensation of water forming clouds; and the eventual precipitation back to earth as rain (or snow or ice), returning in due course to rivers, lakes and oceans.

This is also evident from the fact that he does not wonder where the waters of the flood *drained* when the rains stopped. He writes: "*and the rain from heaven was restrained. And the waters returned from off the earth continually*" (8:2b-3a); and "*and the waters decreased continually*" (8:5), but he does not say where these waters went. Presumably, he thought of them as going back wherever they came

from. There was, in fact, nowhere for these waters to go, since all spaces on earth capable of holding water (oceans, etc.) were *already* full of water.

Also, the rate of drainage would have been extraordinary: under the Everest hypothesis, roughly **26 million cubic kilometers per day**, and under the Ararat hypothesis, about **15 million cubic kilometers per day**, and that **every day for 175 days**. For perspective, the Amazon River — draining the largest river basin on Earth — discharges only about 18 cubic kilometers per day. Draining the floodwaters would therefore have required flows approximately 1,460,000 times greater than the Amazon's discharge in the Everest scenario, or about 828,000 times greater in the Ararat scenario — rates that are physically implausible.

The following is a scientific clarification of the physical impossibility of the drainage scenario proposed by the biblical text.

Viewed from the standpoint of planetary physics, the drainage problem becomes stark. Removing millions of cubic kilometers of water per day means that the water must physically be transferred somewhere, yet Earth offers no realistic sink. Expulsion into space would require accelerating an ocean's worth of mass to escape velocity, demanding energies comparable to catastrophic planetary events. Storage within the crust is impossible, since the total pore space of rocks and sediments is only a minute fraction of the required volume, and forcing water downward at such rates would generate pressures sufficient to fracture and heat the lithosphere on a global scale. Simply redistributing the water across the surface provides no mechanism for loss, because once mountains are submerged, the oceans already occupy gravitational equilibrium with no 'downhill outlet.' Rapid evaporation is likewise excluded, as the latent heat required to vaporize billions of cubic kilometers of water would raise temperatures to levels incompatible with life. Consequently, independent of how the waters might have arrived, known constraints of mass, energy, and rock mechanics make their removal on the required timescales physically untenable.

Clearly, the biblical narrative under scrutiny is scientifically inconceivable and therefore has no credibility. What then should we conclude from the above reflections? Obviously, the story of the flood as presented in Genesis is fictional. It cannot be a report of historical fact, even if it was maybe based on a vague memory of some great disaster in the region. There might have been a massive local or regional flood somewhere; but it could not possibly have been a global flood. The waters may well have been exceptionally high locally, and lasted unusually long, but the figures given in Genesis cannot reasonably be claimed as true.

That is, unless it is assumed that God – *ad hoc* for this precise purpose – miraculously created *ex nihilo* (gradually, over a period of 40 days) the vast

quantity of water required for such a great flood, and then made this massive body of water miraculously totally disappear *in nihilum* (again, gradually, over a period of 175 days), leaving *no trace* of the Flood anywhere on planet Earth. Or maybe He brought over the water from outer space (over 40 days) and then sent it all back there (over 175 days). These are clearly very fanciful assumptions; but no doubt some people will prefer to cling to them so as not to put any part of the Torah in doubt. We can imagine all sorts of miracles, but that does not prove they occurred.

It should be remembered that the entire critique presented above was developed on the assumption of a spherical-Earth cosmology. The narrator(s) of the Deluge story, however, lived in a time and culture in which a flat Earth was the prevailing conception, and this may help explain why the scenario of a world flood did not strike them as physically impossible. Under such a worldview, the problems of flooding and drainage would perhaps be reduced, or at least different. For example, the narrator(s) may have supposed that any surplus waters would be restrained from spilling over the edges of the Earth by the solid dome of the firmament. In any case, since the Earth is in fact spherical and not flat, speculation about the implications of a flat-Earth cosmology has little relevance.

Let us now estimate the **geophysical consequences** of a global flood to the highest peaks, lasting one year all told, leaving aside for now its effects on living things.

Viewed in purely physical terms, a year-long flood rising to the tops of the highest mountains would be an event of staggering violence. Water is heavy, and covering the continents with kilometers of it would press down on the Earth's surface with immense force. The planet's crust can deform under great weight, but only very slowly, over vast stretches of time. A sudden global load of this magnitude would instead produce extreme strain — triggering massive earthquakes, rupturing faults, and destabilizing the ground on a worldwide scale. Meanwhile, such a global ocean could not remain calm. Driven by gravity, winds, and temperature differences, the waters would surge relentlessly across the planet, scouring the land, stripping away soils, tearing loose sediments, and collapsing mountain slopes.

The geological consequences would be unmistakable. The continents would be blanketed by a single, worldwide layer of newly deposited material, created in a geologically instantaneous event. Vast quantities of rock and debris would be ripped up, transported, and redeposited. Coastlines and ocean floors would suffer enormous collapses, sending gigantic underwater avalanches across the seabed. The moving waters — including waves of unimaginable size and persistent, powerful currents — would carve deep scars into the landscape. In short, squeezing such overwhelming physical forces into a single year would rival the most

catastrophic events known in Earth's history, such as major asteroid impacts, and would inevitably leave dramatic and unmistakable traces across the globe.

It must be appreciated that the flood described in Genesis would represent a planetary-scale catastrophe. By comparison, the sea-parting recounted in Exodus 14 is depicted as a local and transient phenomenon, leaving no enduring geological signature. A truly global cataclysm implies a disturbance of Earth systems on an incomparably larger scale which would be expected to leave clear physical traces unless they were entirely removed by Divine intervention. Of course, the Creator of the universe could do that, but why would He? If such an event were intended as a lasting lesson for humanity, one might reasonably expect some residual evidence.

The well-documented mass-extinction event approximately 66 million years ago illustrates this principle: the impact of a large asteroid (about 10–12 km in diameter) excavated an enormous crater (roughly 180 km wide) beneath the Gulf of Mexico and left behind numerous lasting physical signatures.

A comparable global inundation occurring only a few thousand years ago would, by the same reasoning, be expected to leave abundant and unmistakable *geological evidence* across the planet, including a single, thick layer of mud and sand covering the continents, a chaotic mix of land and sea fossils all jumbled together, giant tsunami deposits stretching across whole regions, vast areas of stripped and scoured land, sediments rapidly burying everything in their path, and clear, worldwide patterns in ice layers and tree rings that record the event.

Since no such evidence of a global flood occurring a few thousand years ago has been uncovered to date, we are logically compelled to conclude that such an event did not, in reality, take place. A Scriptural account written one or two millennia later cannot by itself constitute sufficient evidence. The narrative must therefore be understood as legendary rather than historical.

Many Jewish commentators have recognized and attempted to address the numerous difficulties inherent in the biblical flood story. Yet to readers informed by modern scientific knowledge, some of these explanations may appear unconvincing or overly speculative[37]. The traditional interpretive framework often proceeds from a prior commitment: the Torah is assumed to be literally true. Consequently, when tensions arise between the text and scientific conclusions, the

37 An amusing example is the comment by Ramban (Nachmanides, Spain, 1194-1270 CE) on Genesis 8:5: "It is known that the Greek mountain Olympus is very much higher than they [the mountains of Ararat], and the land of Ararat, which is near Babylon, lies in the lower part of the globe!" This reverses actual topography, as Mount Ararat (5,137m) exceeds Olympus (2,917m), and Ararat is far from Babylon.

difficulty is frequently resolved by questioning the scientific account rather than the scriptural one. In this view, where Torah and Science appear to conflict, scriptural authority is taken as decisive. While such an approach reflects deep faith and reverence for tradition, it sits uneasily with the methodological principles of scientific inquiry. Intellectual consistency requires that empirical and logical evidence be taken seriously, even when doing so challenges long-held assumptions.

It should also be borne in mind that, four thousand years ago, the world's population was far from sparse, despite the Flood narrative's silence on numbers. Modern estimates suggest a global population of roughly **27–50 million people**, based on archaeological surveys, settlement patterns, and demographic modeling. Humanity was already widely dispersed, and many societies had attained significant levels of social organization. Populations existed not only throughout Africa, Europe, and Asia, but also in Australia and the Americas — regions entirely unknown to the authors of the biblical text. The great pyramids of Egypt already stood, along with numerous other monuments of early civilizations. World history did not abruptly halt and restart. Even a cursory study of books on world history makes clear that no such universal break in human continuity could possibly have occurred.

Let us now wonder what **traces of a global flood**, if any, have been found:

No evidence exists of a worldwide reset caused by a cataclysmic flood. The survival of the pyramids and other ancient monuments provides strong evidence against a global flood of the magnitude described in Genesis. The Great Pyramids of Giza, already centuries old by the traditional Flood date of roughly 2005 BCE, would have been catastrophically damaged or displaced by waters rising thousands of meters above sea level. Yet they remain largely intact, showing only normal weathering and erosion consistent with centuries of exposure, not submersion under a global deluge.

A Flood covering the earth to the height of the highest mountains would also have deposited thick layers of mud and debris across all land. Archaeological surveys, however, reveal no such universal sedimentary layer. Evidence shows continuous human activity in Egypt, Mesopotamia, the Indus Valley, China, and other regions, with no interruption consistent with a sudden global inundation. Written records, carvings, and symbolic inscriptions spanning periods before and after the supposed Flood survive unbroken, which would have been impossible if all land had been submerged. The intact survival of monuments, settlements, and records makes a literal global Flood historically and scientifically untenable.

This critical evaluation of the story should not make us forget or downplay its great moral significance. It is a parable, not to be taken as factually accurate; but the moral lesson it preaches is undoubtedly true and profound, universal and eternal. *If*

mankind opts for vice and folly, it heads straight for its own destruction. This applies equally to individuals and to groups. Much has been written on this story by rabbinical commentators, and their homiletics remain valid even if the story is not taken literally.

Nonetheless, it must be admitted that debunking the historicity of a worldwide flood in Noah's time, as here done, diminishes the spiritual force of this Torah message. What is unfortunately lost is the comforting thought that if most of mankind went too wild, God would interfere forcefully and straighten things out, eliminating the evil people and saving the good ones. But of course, looking at history, for instance at the recent Holocaust of 6 million Jews by the Nazis and others, we sadly do not see God manifestly intervening in a timely and proportionate way. Perhaps He did get involved behind the scenes, by helping the Allies to destroy the Nazis before all Jews were killed, but that happened rather late in the day. There was, to be sure, an inexplicable eclipse of Divine salvation at that time.

A modern, unorthodox commentary. Finally, I'd like to draw attention to the implications in the present context of Richard Elliott Friedman's *The Bible with Sources Revealed*[38] – Genesis 6-8 is presented in that book as a skillful intertwining of two earlier narratives, one by an author named **J** and the other by one named **P**. This reading[39] explains the many apparent repetitions and inconsistencies in the merged text. I cannot here go into the many interesting justifications that are offered for this thesis[40], but will only compare the two flooding and drainage narratives implied by it.

a. The **J narrative** gives no starting date (v. 7:6 belongs to P, not J); it advocates 40 days of rain (7:12, 17-19), waters rising to 15 cubits above mountains

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38 Friedman is a renowned biblical scholar and professor of Jewish Studies at the University of Georgia. His book *The Bible with Sources Revealed* (2003) is an ingenious color-coded edition of the Torah based on the Documentary Hypothesis of 'Higher Criticism'. In this volume, the text attributed to each of the four presumed ancient authors of the Torah text (J, E, P, D) is printed in a different color, making it easy to read what each is supposed to have written.

39 For the record, Friedman splits Genesis 6-8 as follows: Source J comprises 6:1-8; 7:1-7, 10, 12, 16b-20, 22-23; 8:2b-3a, 6, 8-12, 13b, 20-22. Source P comprises 6:9b-22; 7:8-9, 11, 13-16a, 21, 24; 8:1-2a, 3b-5, 7, 13a, 14-19. Note 6:9a is attributed to a redactor called RJE and 7:6a to another, unspecified source.

40 To give one example, vv. 6:19–20 (P) conflicts with vv. 7:2–3 (J), because the former gives a simple "two of every kind" instruction, whereas the latter distinguishes clean/unclean and requires seven pairs of animals fit for sacrifice. Read straight through, the text seems to give two different Divine instructions about the numbers. This is explained by Friedman by pointing out that in P, there are no animal sacrifices until Exodus 40, whereas in J Noah sacrifices after the flood.

(7:20), and 40 days drainage (8:2b, 3a, 6). It does not mention the ark landing on Mt. Ararat, nor when the mountains tops become visible. It mentions three doves (but no raven): the first dove is sent out at the end of 40 days (8:8-9), it finds no resting place, and presumably returns same evening; the second dove is sent out after 7 more days (8:10), and returns same evening with olive leaf, whence Noah knows that waters have eased (8:11); the third dove is sent out after 7 additional days, and does not return (8:12); at that point (presumably on the same day as the third dove is sent out and does not return), Noah opens ark cover and sees earth is dry (8:13b); there is no distinction here between almost and fully dry. So, according to **J**, there were **40 days of flooding and** (40+7+7=) **54 days of drainage**, making a total of 94 days.

b. The **P narrative** is very different. It starts on 17th day of the second month of Noah's 600th year[41], and ends on the 27th day of the second month of Noah's 601st year, and thus lasts one Hebrew calendar year plus 11 days. This narrative *does not mention rain at all*, but refers the source of flooding to "all the fountains of the great deep" breaking up and "the windows of heaven" opening (7:11). As Friedman remarks in a footnote, this cosmography corresponds to that in Genesis 1, also attributed to source P (and nowhere found in source J). The Flood rises through said upper and lower sources over 150 days (7:24)[42]. After those 150 days, the waters start receding (8:3b). The arks rest on Ararat on the 17th day of the 7th month (8:4), i.e. exactly 5 months after flooding began. This suggests that the drifting ark settled on Mt. Ararat just as drainage began, or maybe 2-3 days before that (depending on lengths of the months concerned). The floodwaters go on receding until mountains become visible on the 1st day of the 10th month (8:5), which means after say (2+13+29+30+1=) 75 days of drainage. At this point, a raven is sent out and apparently stays away (8:7). In the 1st day of the 1st month of Noah's 601st year, "the waters dried from on the earth" (8:13), which means 3 months after the 1st day of the 10th month, say (28+30+29+1=) 88 days more drainage. Then on the 27th day of the second month of Noah's 601st year, "the earth dried up" (8:14), which means another say (29+27=) 56 days of final drainage. Thus, according to **P**, there were **150 days of flooding and** about (75+88+56=) **219 days of drainage**, making a total of about 369 days.

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41 I take the text to measure time relative to Noah's birthday, without specifying where in the general calendar that birthday falls.

42 Notice that whereas in the traditional, interwoven narrative the 150 days constitute an unexplained (why would God do that?) period of neither flooding nor receding, due that narrative including the 40 days of rain, in the P narrative, the 150 days become the days of flooding, because the 40 days of rain belong exclusively in the J narrative.

Evidently the J and P narratives are very different from each other and from the traditional merged narrative with respect to timing. The traditional narrative differs significantly from the P narrative with regard to the 150 days of waters "prevailing" — in the former this must be interpreted as waters neither increasing nor decreasing (since flooding through rain precedes the 150 days and drainage begins after them), whereas in the latter this must be the period of flooding since there is no rain before it). I personally find, all things considered, the documentary hypothesis to be in this instance rather convincing.

Finally, it is worth comparing the rates of flooding and drainage in J, P, and the traditional merged narrative, which we can call JP. Flooding took 40, 150, and 40 days, respectively; while drainage took 54, 219, and 175 days, respectively. Clearly, flooding in less time means proportionately more water inflow daily; while drainage in less time means proportionately more water outflow daily. The greater the daily water inflow or outflow, the more violent the event.

2. Noah's ark and its cargo

The following is a selective list of Genesis 6 verses relevant to the discussion of Noah's ark and its cargo.

> **6:**13 And God said unto Noah: 'The end of all flesh is come before Me; for the earth is filled with violence through them; and, behold, I will destroy them with the earth. 14 Make thee an ark of gopher wood; with rooms shalt thou make the ark, and shalt pitch it within and without with pitch. 15 And this is how thou shalt make it: the length of the ark three hundred cubits, the breadth of it fifty cubits, and the height of it thirty cubits. 16 A light shalt thou make to the ark, and to a cubit shalt thou finish it upward; and the door of the ark shalt thou set in the side thereof; with lower, second, and third stories shalt thou make it. 17 And I, behold, I do bring the flood of waters upon the earth, to destroy all flesh, wherein is the breath of life, from under heaven; every thing that is in the earth shall perish. 18 But I will establish My covenant with thee; and thou shalt come into the ark, thou, and thy sons, and thy wife, and thy sons' wives with thee. 19 And of every living thing of all flesh, two of every sort shalt thou bring into the ark, to keep them alive with thee; they shall be male and female. 20 Of the fowl after their kind, and of the cattle after their kind, of every creeping thing of the ground after its kind, two of every sort shall come unto thee, to keep them alive. 21 And take thou unto thee of all food that is eaten, and gather it to thee; and it shall

be for food for thee, and for them. 22 Thus did Noah; according to all that God commanded him, so did he.

We must now, looking at Genesis 6, consider the dimensions (L × W × H) of the ark in meters, the volume and surface area of each of its three decks, and their combined volume and surface area, its probable weight in kilograms (based on the weight of "gopher wood" — we do not know precisely what gopher wood was; possible identifications include cypress, pine, and fir), how much water it would displace (draft) empty, how high its water line would then be, and how much weight it could bear without sinking.

The ark was 300 cubits long, 50 cubits wide, and 30 cubits high. In meters (1 cubit ≈ 0.445 m), this is about 133.5 m long, 22.25 m wide, and 13.35 m high. Divided into three stories, each level would have been roughly 4.45 m high. Each deck would have provided about 2,970 m^2 of floor space, giving a total of about 8,910 m^2 across the three levels. The total internal volume would have been about 39,600 m^3, with each story containing roughly 13,200 m^3. If, for purposes of a rough engineering model, we assume a wood density of 700–800 kg/m^3 and an average structural thickness of about 0.3 m, the weight of the hull and structure might be estimated at roughly 4,000–5,000 metric tons.

Using the ark's footprint (that is, 2,970 m^2) and the principle of buoyancy, an empty ark would float with a waterline (the level where water meets the side of the ark) of about 1.35–1.7 m. When fully loaded, it could in principle displace up to about 35,000 metric tons, although the actual permissible cargo would be less because the ark itself would account for several thousand tons of that displacement. At maximum load, the submerged depth (called the draft) would be roughly 11.8 m, leaving about 1.5–1.7 m of freeboard — the part of the hull (the body of the ark) remaining above the water. Its sheer size makes it comparable in enclosed volume to a modern medium-sized container vessel.

The ark's wide beam, or width, would have given it unusual stability, making it resistant to rolling even in rough waves. This advantage would have been greatest if the heaviest materials had been stored on the lower decks and, on each deck, concentrated near the center, keeping the overall center of gravity low and minimizing the tendency of the cargo to shift the vessel sideways, while lighter cargo occupied the outer and upper areas. Internal compartments could also have prevented the cargo from shifting dangerously. With its broad base, reserve buoyancy, slow and gentle rolling motion, and favorable loading arrangement, the ark might have behaved less like a conventional ship than like a massive floating platform or warehouse, with considerable resistance to capsizing.

Even so, the ark would still have faced significant challenges. A flat, rectangular hull concentrates structural stresses and would therefore have required strong internal framing to withstand bending forces and the impact of waves. Its freeboard — the height of the deck above the water — would have been relatively modest, allowing large waves to wash over the deck. Its dynamic stability would also have depended on careful loading: if cargo shifted or too much weight was placed high or too far off-center in the structure, the risk of tipping would increase.

These conclusions and figures are based on rough naval-engineering calculations, omitted here for simplicity, involving buoyancy, stability, and ship dynamics. They suggest that the ark's size, shape, and buoyancy could have enabled it to carry an enormous cargo while remaining dynamically stable in rough seas. Its seaworthiness, however, would have depended on secure compartments, disciplined weight distribution, and sufficiently strong structural design. In essence, it could have floated fully loaded as a colossal drifting warehouse, highly resistant to capsizing but still dependent on careful preparation and sound engineering.

Building such a vessel would have been an extraordinary undertaking. The construction of the ark would have required only tools and techniques well within the capabilities of ancient woodworking. Tree-felling axes, adzes for shaping timbers, chisels, drills, saws, ropes, and sealing materials such as pitch or bitumen were all known and widely used in antiquity. Large wooden structures could be assembled using sophisticated joinery methods, including mortise-and-tenon joints and wooden pegs, without reliance on metal nails. Ancient civilizations demonstrably possessed the skills needed to work massive timbers and build durable waterborne vessels. The principal difficulty lies not in the technology but in the scale. Thus, while the ark's description requires no unknown methods, it does imply a project of exceptional magnitude compared with known ancient shipbuilding practice.

According to Genesis 6:3, God said that human lifespan would be limited to 120 years — a period later interpreted in Jewish tradition, as reflected in Genesis Rabbah 30:7 and cited by Rashi on Genesis 6:14, as the time Noah spent preparing for the Flood and building the ark. Working alone, Noah would have had to fell, transport, and shape enormous quantities of gopher wood, assemble the hull, construct three decks, create internal compartments, and caulk the vessel to make it watertight. Even with continuous work using primitive tools, this process could plausibly have taken several decades, perhaps at least 60-70 years, which is consistent with the traditional 120-year timeframe. With help from his family, the work could have been completed more quickly, but the tradition emphasizes Noah's solitary dedication as a demonstration of perseverance, skill, and faith.

It is worth pausing to appreciate just how large and spacious the ark was, for it is depicted in some artworks as rather small. Note that Noah and his family, presumed (see below) to occupy the upper deck together with the food and water supplies they needed for at least one year, would have had almost 3,000 m² to live in — an enormous amount of living space for eight people.

Let us now absorb a quick lesson in modern **taxonomy**. Biologists organize living things into nested groups, a system called taxonomy. In broad outline, taxonomy moves from the very broad to the very specific — Domain → Kingdom → Phylum → Class → Order → Family → Genus → Species — providing a systematic way to describe and understand the enormous diversity of life on Earth.

At the broadest level are domains and kingdoms. Modern biology recognizes three domains of life — Bacteria, Archaea, and Eukarya. Within Eukarya, which includes animals, plants, fungi, and protists, biologists commonly distinguish several kingdoms, although the precise number varies among classification systems. Within these kingdoms, organisms are grouped into phyla (singular: phylum). Plants are divided into several major phyla, while the animal kingdom contains roughly three dozen recognized phyla. Phyla represent major evolutionary lineages and, especially in animals, often correspond to major body plans.

Phyla are subdivided into classes. For example, the phylum **Chordata**, which includes all vertebrates as well as some non-vertebrate animals, is divided into classes including (but not limited to) mammals, birds, reptiles, amphibians, and fishes. Classes are further divided into orders, then families, which group related genera. Within families, genera (singular: genus) contain closely related species. For example, the genus *Canis* contains wolves, coyotes, and several other closely related species, including the domestic dog. The numbers of recognized families and genera are continually revised as biological classification changes; there are thousands of animal families and tens of thousands of animal genera.

Finally, at the level most familiar to us, there are **species**. Under the biological species concept, a species consists broadly of organisms capable of interbreeding and producing fertile offspring. This definition, however, does not apply equally well to all forms of life, and biologists use several different species concepts. In modern evolutionary biology, a species is generally understood as a separately evolving lineage. Species are typically distinguished by substantial genetic divergence and often by clear phenotypic differences, but what ultimately matters is that they follow separate evolutionary trajectories, usually because reproductive isolation has developed over time.

A **subspecies**, by contrast, is a geographically or otherwise distinctly distributed population within a species that has developed heritable differences in phenotype

and detectable genetic differentiation but has not become fully independent as a species. Subspecies remain part of a single species because they can generally still interbreed and produce fertile offspring where their ranges meet. The boundary between species and subspecies is not always sharp, and biologists use different species concepts and taxonomic criteria in different groups. Taxonomy is also continually revised as new genetic, morphological, geographical, and behavioral evidence becomes available. Determining and classifying such distinctions is therefore a complex task, requiring biologists to weigh and interpret evidence from multiple sources.

The time required for evolutionary divergence varies widely among groups and circumstances. Taxonomic groups become progressively more specific as one moves from broad groups such as families or genera to species and finally to subspecies. If a single ancestral pair were taken to represent such a broad group, the problem would then be to account for the subsequent diversification of that ancestral population into all the distinct species and subspecies within the group. For many birds and mammals, divergence from a common ancestor to clearly distinct species often takes hundreds of thousands to millions of years, although substantially faster cases are known. Subspecies-level differentiation can arise over shorter periods, sometimes within tens or hundreds of thousands of years, depending on the strength of geographic isolation, natural selection, genetic drift, and other evolutionary factors, but it too generally requires considerable time. Thus, if the proposed ancestral unit is defined at the level of a broad grouping such as a family or genus, the roughly four thousand years since the supposed Flood would, in most cases, be far too short to account for the extensive species and subspecific diversity observed today.[43]

This has a direct bearing on the narrative of Noah's ark. If one assumes a literal global flood only about four thousand years ago, the ark would have had to preserve not merely representatives of all the modern species but, in effect, representatives of the distinct subspecific forms that existed at that time. The roughly four millennia between such a deluge and the present would not, under standard population-genetic and phylogenetic estimates, provide enough time to generate the enormous

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[43] Some apologetic authors have used a broader taxonomic category than species when estimating the number of animals on the Ark. John Woodmorappe, for example, used the genus as a working approximation of the biblical "kind," while more recent Answers in Genesis material generally places the "kind" at approximately the family level. These approaches effectively assume that much of today's species and subspecies diversity developed from these broader ancestral groups after the Flood. My analysis takes a different approach, based more explicitly on modern evolutionary timescales and the time required for such diversification.

diversity of recognizable subspecies found today from a drastically reduced set of survivors. Thus, even before we attempt to count the animals to be loaded on the ark, modern evolutionary biology gives us reason to consider the finest currently recognized taxonomic units rather than simply assuming that a single baseline pair of animals could subsequently give rise to all the diversity we now observe.

Before attempting to calculate the number of biblical "kinds" (Hebrew *min*) that were taken aboard Noah's ark, an important taxonomic point must be made. The biblical term "kind" (*min*) does not correspond neatly to any one modern taxonomic category; it may refer to a species or a subspecies. But a subspecies is not a taxonomic unit existing alongside the species to which it belongs; it is a subdivision within that species. If, for example, a species X contains three recognized subspecies A, B, and C, we do not count X + A + B + C as four "kinds." Conversely, if species Y has no recognized subspecies, Y itself counts as one "kind." In other words, where recognized subspecies exist, they replace the parent species in our count; where no subspecies are recognized, the species itself is counted.

Around 1.5 million animal species have been formally described, along with hundreds of thousands of plant species, while many more are thought to remain undiscovered, particularly among insects, microorganisms, and other poorly studied groups. We shall here focus only on the major terrestrial and freshwater vertebrate groups relevant to the ark — mammals, birds, reptiles, and amphibians. The non-vertebrate chordates, as well as the many other animal groups such as insects, spiders and other arthropods, mollusks, and worms, are not included in our calculation. We must presume, however, that non-aquatic members of these groups that could not survive the Flood outside the ark were also taken aboard. Their enormous diversity would create additional problems of containment, feeding, and hygiene, but their total biomass would be tiny compared with that of the vertebrates considered here. For simplicity, therefore, we shall disregard them in the quantitative calculation, without materially affecting our conclusions concerning total animal mass and volume.

For example, if roughly the 900,000–1,000,000 currently known insect species were represented by two individuals per species, and we assumed an average body mass of only 0.01 grams, their combined biomass would be only about 18–20 kilograms. Their food requirements would nevertheless be remarkably diverse. Different insects might require leaves, seeds, nectar, fruits, decaying organic matter, fungi, or other insects. Thus, although their body mass would add very little to the total, keeping such a collection of insects alive would introduce yet another layer of logistical complexity.

A recent comparative study gives roughly 6,900 mammal species, 11,100 bird species, 12,600 reptile species, and 9,100 amphibian species. Substantial numbers of mammal, bird, and reptile species are divided into recognized subspecies, whereas currently accepted amphibian taxonomy recognizes no valid subspecies. A recent comparative study of tetrapod taxonomy found recognized subspecies in about 22.3 percent of mammal species, 43.4 percent of bird species, and 9.3 percent of reptile species, while finding no currently accepted amphibian subspecies. The study identified approximately 5,914 accepted mammalian subspecies, 17,465 bird subspecies, and 2,923 reptile subspecies. These figures come from a common comparative dataset and are therefore useful for our purpose, although taxonomic databases are continually revised and the figures should not be regarded as permanently fixed.[44]

Translating these figures into biblical "kinds," they imply **approximately 11,300 mammalian kinds, 23,800 bird kinds, 14,400 reptilian kinds, and 9,100 amphibian kinds**[45]. The total is therefore approximately 58,600, which we can reasonably round to **about 59,000 chordate "kinds"**. The calculation is necessarily approximate, because some kinds may have become extinct or newly arisen during the roughly four thousand years since the Flood and because the underlying taxonomic sources and their dates of revision are not perfectly synchronized. It follows that two representatives of each of approximately 59,000 kinds would mean roughly **118,000 individual animals** were taken aboard the ark. A few additional animals and birds were taken aboard for sacrificial purposes after the Flood, but their number is too small to affect this total (Genesis 7:2–3 and 8:20).

We shall now estimate the total body mass of the animals taken aboard the ark. For purposes of this calculation, we use probability-weighted representative body masses for each group, accounting for the natural size-frequency distribution of biological species. While global arithmetic means are heavily skewed upward by rare megafauna (such as elephants or large pythons), a size-frequency weighted

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[44] J. J. M. Guedes, J. A. F. Diniz-Filho, A. V. L. Freitas, and M. R. Moura, "Subspecies taxonomy reflects social and geographic patterns of taxonomic effort in tetrapods," *Conservation Biology* (2026), e70356, doi:10.1111/cobi.70356. The study used the Catalogue of Life and other taxonomic databases and reported the figures cited here.

[45] The calculation treats recognized subspecies as replacing, rather than being added to, their parent species. Thus, for mammals, approximately 77.7 percent of the 6,900 species without recognized subspecies are counted as species-level kinds (about 5,361), while the approximately 5,914 recognized mammalian subspecies are counted separately, giving about 11,275, rounded to 11,300 kinds. The same calculation gives approximately 23,800 bird kinds and 14,400 reptile kinds; amphibian species are counted directly because no currently accepted subspecies were identified.

estimate reflects the reality that the vast majority of vertebrate species are small-bodied. Accordingly, we use **2.0 kg for mammals** (reflecting the dominance of small rodents and shrews), **0.04 kg (40 g) for birds** (consistent with data showing that more than half of bird species weigh less than 38 g), **0.25 kg for reptiles**, and **0.01 kg (10 g) for amphibians**. These figures provide a plausible working baseline for estimating the total mass of the animals aboard the ark.[46]

The calculation is as follows: 11,300 mammalian kinds × 2 individuals × 2.0 kg = 45,200 kg; 23,800 bird kinds × 2 × 0.04 kg = 1,904 kg; 14,400 reptilian kinds × 2 × 0.25 kg = 7,200 kg; and 9,100 amphibian kinds × 2 × 0.01 kg = 182 kg. The combined body mass is therefore approximately **54.5 metric tons**. At approximately the density of water, their bodies would occupy roughly **54.5 cubic meters**. Vertebrates are, on average, somewhat denser than water because of their protein, mineral, and other solid components, although body fat and air-filled cavities partly offset this; for simplicity, it is better to ignore these variations than to introduce a more precise but somewhat artificial figure. Compared with the ark's estimated total internal volume of about 39,600 cubic meters, the corresponding volume of about 54.5 cubic meters is remarkably little — only about 0.14 percent of the total volume. Even if all the animals were placed on a single deck, their body volume would occupy only about 0.41 percent of that deck's volume — **less than half of one percent**.

Living creatures cannot be treated like stored goods. Even if their combined physical volume occupies only a fraction of the ark’s capacity, the animals would require additional functional space beyond their physical footprints for standing, turning, moving, and lying down without injury or stress. The floor area required to house them is therefore potentially more significant, although it is much harder to estimate. Large species are particularly important in this respect: elephants, giraffes, cattle, horses, camels, and other sizeable mammals require substantial

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[46] Methodological note on body-mass estimation and frequency distribution: In macroecological modeling, calculating the "average" mass of a taxonomic group presents a major statistical pitfall due to right-skewed log-normal distributions. In nature, tiny species (such as mice, small lizards, and warblers) vastly outnumber massive ones (such as elephants, ostriches, or pythons). If one uses a standard global arithmetic mean—which is heavily dragged upward by the extreme mass of rare megafauna—the calculation implicitly treats every rodent, shrew, and small reptile as a medium-sized mammal or large pet, drastically overestimating total biomass. To correct for this, the multipliers used here apply a *size-frequency weighting* (or median-weighted approximation) derived from tetrapod body-size distributions (see, e.g., F. S. Caron and M. R. Pie, “The Evolution of Body Size in Terrestrial Tetrapods,” *Evolutionary Biology* 51 [2024]: 283–294), ensuring the baseline figures accurately reflect true biodiversity distributions.

floor area for normal movement. A relatively small number of such large-bodied animals could therefore consume a substantial portion of the usable deck surface.

The number of animals that could practically be housed within a given area would also be limited by their behavior and compatibility. Predators must be separated from prey, aggressive animals from rivals, and territorial species from intruders. Animals with substantially different environmental requirements would likewise generally need separate enclosures. Partitions, stalls, corridors, internal air passages, and access routes for feeding and cleaning would therefore be unavoidable. With every practical requirement, theoretical capacity would increasingly give way to shrinking usable space.

On the other hand, the almost 4.5-meter height of each deck could potentially have been exploited by keeping many smaller animals in vertically stacked cages, allowing them to occupy less floor area overall. Where animals of different kinds could safely coexist in a shared small space, they could also be housed together in some enclosures, further reducing the floor area required. Such arrangements could not be used universally, but where they were feasible, they could make more efficient use of the available floor area. In effect, Noah and his family would have had to master, on an enormous scale, the challenging problems of zoo husbandry and animal management.

Estimating the food and water required by such a heterogeneous collection of animals is a complex physiological problem, heavily influenced by body size. Because metabolic rates scale allometrically with mass, small endotherms (such as small birds and rodents) consume a disproportionately large fraction of their body mass daily — often 15% to 30% of their weight — whereas large mammals typically consume only 2% to 3%. Reptiles and amphibians have much lower metabolic requirements, though their vast taxonomic diversity creates wide variation. Water requirements follow a similar physiological scaling. Small endotherms require substantial water relative to their mass, while reptiles and amphibians require significantly less, often obtaining a major fraction of their hydration directly from food. Feeding animals dry stored provisions rather than fresh forage further elevates drinking water demands.

When accounting for the true size-frequency distribution of the population — where tiny, high-metabolism species vastly outnumber large ones — aggregate requirements must be adjusted upward relative to simple linear livestock averages. For our calculation, we apply frequency-weighted overall averages of **7 percent of total body mass per day for dry food and 75 liters of water per metric ton of body mass per day**. While these figures remain generalized working estimates, they reflect reasonably well the metabolic realities of a vertebrate assemblage

dominated by small-bodied kinds. As subsequent calculations will show, while the animals themselves represent a manageable physical volume, sustaining them for an entire year requires provisions weighing and occupying many times the collective mass of the animals.[47]

The volume occupied by the food would depend greatly on what the heterogeneous collection of animals were fed. Under a purely naturalistic reconstruction, the carnivores would require, in the absence of fresh meat, salted or smoked meat, but the biblical narrative does not specify what they ate. For the purposes of the calculation, we shall assume that these normally predatory animals were fed entirely on stored grains and legumes. Maintaining such a diverse collection of specialized predators for an entire year would have been an extraordinary undertaking.[48]

Grain crops such as wheat and barley, along with legumes such as beans and lentils, are relatively dense, whereas hay, dried vegetation, leaves, and similar materials are much bulkier. Published historical and agricultural figures indicate that uncompressed pre-industrial hay and loose fodder range from roughly 50 to 80 kg per cubic meter, while primitive, uncompressed stored grains and pulses range significantly lower than modern industrial densities, averaging roughly 350 to 450 kg per cubic meter. Because the ark's animals would have required a wide variety of foodstuffs, and operating under the technological constraints of pre-industrial storage where high-pressure baling and heavy commercial pelleting were

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[47] Methodological note on metabolic scaling and aggregate provisions: Estimating aggregate consumption for a diverse cross-section of vertebrates requires accounting for mass-specific metabolic scaling (often generalized via Kleiber-type relationships). Metabolic rate per unit of mass decreases as body size increases. Consequently, applying flat consumption percentages derived from large livestock (such as cattle or horses) severely underestimates the food and water requirements of populations dominated by small-bodied species, where mass-specific turnover is an order of magnitude higher. To correct for this, the consumption factors used here—viz. 6-8% of body mass daily for dry food and 70-80 liters per metric ton daily for water—incorporate a frequency-weighted adjustment that accounts for the metabolic intensity of small mammals, birds, and squamates. This bridges the gap between large-mammal agricultural baselines and the physiological realities of micro-vertebrates, providing a reasonably robust foundation for subsequent logistical and spatial calculations.

[48] Classical Jewish commentators addressed this issue by invoking miraculous accommodation. Abarbanel, for example, states that God commanded the carnivores to consume only seeds and plants to suppress their predatory instincts, a view echoed in Sanhedrin 108b regarding the feeding of the lion, and reinforced by later Midrashic traditions of temporary behavioral changes.

unavailable, we shall assume a lower, more realistic **average bulk density of 180 kg per cubic meter for the stored provisions**.

On this basis, 54.5 metric tons of animals would require about 3.8 metric tons of food (about 7% of their weight) per day, or approximately 1,393 metric tons over a year. At an uncompressed bulk density of 180 kg per cubic meter, this **food** would occupy roughly **7,736 cubic meters**. Water would add another enormous requirement. At 75 liters per metric ton of animal body mass per day, 54.5 metric tons of animals would require about 4.1 metric tons of **water** per day, or approximately **1,492 cubic meters** over a year. Because the surrounding floodwater would have been turbulent, muddy, and laden with sediment and organic debris, it could not safely be relied upon; consequently, we may assume that all drinking water had to be stored internally. **The combined volume of the animal food and water would therefore be roughly 9,228 cubic meters.**

This combined volume of 9,228 cubic meters represents roughly 23 percent of the ark's total estimated internal volume of approximately 39,600 cubic meters. Consequently, storing these provisions within the vessel would leave approximately 30,372 cubic meters available for the approximately 118,000 animals, their enclosures, passages, the eight humans, refuse, and all other necessities of the voyage. The 9,228 cubic meters of animal provisions would occupy about 70 percent of the total volume of any single deck (~13,200 cubic meters). If the provisions were stored specifically on the middle deck, the food alone would occupy about 58.6 percent of a single deck, while the water would occupy another 11.3 percent. This would leave only about 3,972 cubic meters (about 30 percent) of that deck for the animals, their enclosures, movement, access routes, and other requirements. The collective volume of the animals, at approximately 54.5 cubic meters, would theoretically occupy only about 1.4 percent of that remaining space, suggesting that the space itself could be sufficient.

So, as regards geometry — the volume, and possibly the floor-space requirements — the ark seemingly presented no insurmountable problem, granting all our above-mentioned quantitative assumptions. However, once the duration of the voyage is taken seriously, the difficulty shifts decisively from architecture to biology, physiology, and continuous care. The problem is not simply whether the ark’s intended cargo could be accommodated, but whether it could be kept alive and managed throughout approximately one year of confinement under highly demanding conditions, including restricted movement, limited natural light, ventilation, temperature and humidity fluctuations, and the continual challenges of feeding, watering, cleaning, and waste removal. The animals would have differed enormously in size, diet, behavior, habitat and temperature requirements, activity

patterns, and susceptibility to disease. Taken together, these differences would have made the daily management of such a diverse animal population an enormous logistical challenge, quickly bringing the limits of biological feasibility into focus.

Scripture does not specify how long the animals would have to remain aboard, nor does it tell us how Noah knew in advance how much food and water to prepare, or what sorts of food would be required. Yet he needed to know approximately how long the Flood would last in order to store enough provisions for his family and all the animals with them. Procuring and processing these supplies would have been a major undertaking, requiring appropriate agricultural skills, tools, materials, and labor. Adequate storage facilities would also have been needed to hold the food and water required for the journey. Estimating the time needed for all this work is difficult, but we may presume that there was sufficient time.

The biblical account itself does not specify how the people, animals, food and water, and refuse were distributed among the three decks. According to Rashi, based on Sanhedrin 108b, the three decks of the ark had distinct functions: the upper deck was for Noah and his family, the middle deck for the animals, and the lower deck for refuse, although Rashi does not specify where the animals' food or water was stored. Other classical commentators, however, propose somewhat different arrangements in their commentaries on Genesis 6:16. Abarbanel apparently places some of the provisions on the middle deck together with the animals and some on the lower deck, while Chizkuni states that the upper deck was for Noah and his family and the entire food supply. Neither of these commentators, however, explicitly mentions where the drinking water was stored. It is therefore possible that by "food" they understood all nourishment, including water, but this cannot be assumed.[49]

On the basis of the modern quantitative estimates and calculations presented above, we can safely propose that **the most practical arrangement** would have been to keep human food and water on the upper deck, together with Noah's family; animal provisions on the middle deck, close to the animals they were intended for; and to use the lower deck primarily for waste management. This setup would have helped prevent contamination of food and water supplies and reduce the spread of disease among humans and animals.

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[49] Interestingly, Ramban (Nachmanides), commenting on Genesis 6:16 and 6:19, argued that the animals and their provisions could not have fitted into the ark even if there were ten such vessels, and concluded that a miracle must have occurred. But his quantitative conclusion does not withstand the modern analysis presented above: the ark did, in fact, have sufficient space.

Clearly, the storage and distribution of provisions and waste would have been the main difficulty of the enterprise. The lower deck would have had to be effectively sealed off from the middle and upper decks to prevent foul air, moisture, and contamination from reaching the animals and humans on board, while still allowing refuse to be passed down through openings. Such openings would themselves have had to be closable or otherwise designed to prevent the lower deck from compromising hygienic conditions in the decks above. The proposed arrangement would thus separate the major flows of provisions and waste within the ark and make the overall operational task easier.

The true challenge, then, did not lie in static volume but in continuous biological management and care. Feeding, watering, and tending to approximately 118,000 animals continuously would far exceed the capacity of Noah and his family. Even at an implausibly swift average of only one minute of attention per animal per day, the total amounts to nearly 2,000 person-hours daily. Divided among eight people, the one-minute baseline would require more than 240 hours of work per person within every 24-hour day — a manifest physical impossibility without substantial assistance. This immense burden is strikingly anticipated by Sanhedrin 108b, which describes Noah and his family suffering great hardship while feeding animals around the clock.

Over the course of a year, the physiological output of 118,000 animals and eight humans would generate compounding environmental crises. Enclosed within a wooden vessel, this population would continuously consume oxygen while expelling massive quantities of carbon dioxide, metabolic heat, and moisture. Although Genesis 6:16 mentions an opening or window, a craft engineered to withstand extreme flood turbulence could not simply remain open to the elements. Even if this opening provided some passive ventilation, it is hard to imagine it maintaining adequate air exchange for 118,000 animals and eight humans in a sealed wooden vessel. While specialized ventilation systems capable of exchanging air while excluding water are theoretically conceivable, the biblical narrative offers no indication of such infrastructure. Sustaining a breathable atmosphere for some 118,000 breathing creatures without active, sophisticated air management represents a profound — if not insurmountable — engineering hurdle.

Similarly, hundreds to thousands of metric tons of manure and urine would accumulate continuously, occupying several hundred to several thousand cubic meters depending on moisture content, density, and degree of compaction. The precise quantity would depend on the species, their diets, water consumption, and how much consumed material was retained in body tissues or lost through respiration and evaporation. This continuously accumulating waste, together with

the atmospheric challenges just described, would create increasingly serious hygienic and environmental difficulties, even if carefully transferred to and stored in the lower deck until the end of the voyage, making disease, parasites, and stress-related mortality constant risks throughout the voyage.

The ark would function as a largely enclosed biological system in which matter was continuously transformed into heat, moisture, carbon dioxide, and waste. Survival would therefore depend not simply on how much space the ark contained, but on whether these biological flows could be managed continuously for an entire year. Feeding schedules, water provision, waste removal, disease control, moisture management, air circulation, behavioral stress, and simple physical access would become dominant concerns. If any miracle were required, it would therefore not necessarily be to shrink the animals or multiply the physical capacity of the ark, but to ensure that the continuous ecological, sanitary, and husbandry processes of such a closed biosphere could actually function. The geometry may permit the animals and their provisions to be accommodated; biology and husbandry are far less forgiving.

3. People, animals, and vegetation

Let us now focus on the following verses in Genesis:

> **7:**21 And all flesh perished that moved upon the earth, both fowl, and cattle, and beast, and every swarming thing that swarmeth upon the earth, and every man; 22 all in whose nostrils was the breath of the spirit of life, whatsoever was in the dry land, died. 23 And He blotted out every living substance which was upon the face of the ground, both man, and cattle, and creeping thing, and fowl of the heaven; and they were blotted out from the earth; and Noah only was left, and they that were with him in the ark.
>
> **8**: 15 And 'God spoke unto Noah, saying: 16 'Go forth from the ark, thou, and thy wife, and thy sons, and thy sons' wives with thee. 17 Bring forth with thee every living thing that is with thee of all flesh, both fowl, and cattle, and every creeping thing that creepeth upon the earth; that they may swarm in the earth, and be fruitful, and multiply upon the earth.' 18 And Noah went forth, and his sons, and his wife, and his sons' wives with him; 19 every beast, every creeping thing, and every fowl, whatsoever moveth upon the earth, after their families; went forth out of the ark.

As already mentioned, modern scientific estimates place the world's **human** population at the time of the alleged Flood at roughly 27–50 million people. That

is the number of men, women, and children who would have been annihilated in a single year by the global flood. While this number is enormous, comparable losses have occurred in human history. Examples include the Black Death in Europe (1347–1351), which wiped out 25–30 million people, roughly a third of the continent; the Spanish Flu (1918–1919), which caused an estimated 50 million deaths worldwide; and the Second World War (1939–1945), during which roughly 70–85 million lives were lost, nearly 3-4 percent of the world population at the time. All these catastrophes have left reliable documentary and archaeological traces. By contrast, a single-year global flood wiping out tens of millions of people everywhere at once is not recorded in any work of world history and is, moreover, unsupported by any verifiable material evidence.

As mentioned earlier, too, if Noah, his three sons, and their wives were truly the only humans left alive after the Flood, roughly 4,130 years ago, the task of repopulating the world to its present numbers would have been staggering. Modern population genetics allows us to evaluate such scenarios quantitatively. Humans carry a vast amount of genetic diversity across populations, both in mitochondrial DNA, inherited maternally, and the Y chromosome, inherited paternally. Analyses of these genetic markers show that the minimum ancestral population of humans has never dropped to a single family within the last several tens of thousands of years. A bottleneck of only eight individuals would leave unmistakable traces: extreme loss of genetic variation, widespread fixation of rare alleles, and a very high frequency of harmful recessive traits. Yet today, humans display immense genetic diversity, far beyond what could have arisen from eight individuals in just over four millennia. In other words, even granting rapid reproduction under ideal conditions, the genome itself provides strong evidence that humanity was never reduced to a single nuclear family at that time. Modern genetics, therefore, delivers a verdict consistent with its conclusions regarding the Adam and Eve narrative: while the story carries moral and symbolic weight, it cannot be reconciled with empirical evidence about the origins and continuity of our species.

As regards the genealogies of mankind from Noah to Abraham mentioned in Genesis 10-11[50], having established on genetic and historical grounds that Noah and his family could not possibly have been the sole surviving human beings of a worldwide flood, we must logically say that their alleged descendants could not have been as the Torah narrative implies the ancestors of all subsequent humanity. Some or all of them and their alleged descendants might have been real people; but

50 Note in passing that R. E. Friedman attributes these genealogies to P, J, and other sources.

it remains possible that some or all of them were legendary. More will be said on this topic further on.

The same genetic reasoning applies not only to humans but to **all land and airborne animals**. Evidently, the author of the global flood story assumed that a couple of specimens from each species of animal would suffice to regenerate all species in a short while after the flood; but this assumption was absolutely wrong from a scientific point of view.

Modern population genetics shows that species need sufficiently large breeding populations to remain genetically viable and maintain adequate genetic diversity. If every terrestrial species had been reduced only a few thousand years ago to a single pair, the biological consequences would have been severe and manifest. Such an extreme bottleneck drastically reduces variation, amplifies inbreeding, and allows harmful recessive traits to spread rapidly. In small populations, fertility declines, juvenile mortality rises, disease resistance weakens, and extinction risk increases sharply. These effects are not theoretical; they are well documented in conservation biology whenever animal populations collapse.

Historical examples illustrate the principle clearly. Species that have undergone severe bottlenecks show persistent genetic scars. The cheetah, for instance, displays extraordinarily low genetic variation, likely reflecting ancient population crashes; individuals are so genetically similar that skin grafts between unrelated animals are often not rejected. The northern elephant seal, hunted nearly to extinction in the nineteenth century, rebounded numerically but still exhibits reduced genetic diversity today. Yet even these dramatic cases involved thousands of surviving individuals — not two.

By contrast, many modern animal populations number in the hundreds of thousands or millions. African elephants alone are estimated at roughly 400,000 individuals, distributed across diverse habitats. Plains zebras exceed 500,000, while wildebeest populations approach 1.5 million. Even species perceived as rare often consist of tens of thousands of animals. Birds provide an even more striking picture: global populations of some species reach into the hundreds of millions. The common quail, barn swallow, and house sparrow collectively number in the hundreds of millions to over a billion individuals worldwide. Such vast populations contain enormous genetic variation accumulated over long evolutionary timescales.

Had all terrestrial animals passed through a universal two-individual bottleneck only a few thousand years ago, we would observe unmistakable genetic signatures across virtually every species: extreme uniformity, widespread inherited defects, and frequent extinction cascades. Instead, modern genomes reveal deep, branching population histories, long-term separations, and genetic structures incompatible

with a recent global collapse. In purely biological terms, most species would not have survived such an event, let alone diversified into the rich ecological systems observed today.

Regarding **the movement of animals**, the narrative and later traditions imply that pairs of creatures made their way to the ark in time for loading. Rabbinic literature even suggests that the animals came of their own accord, guided by Divine instinct. Then, after the Flood, all the animals are supposed to have returned home to their original habitats. One is thus invited to picture not merely a shipyard scene, but a vast, planet-wide, two-way migration across great distances and under very difficult conditions. The scale and complexity of what this would entail is rarely appreciated.

For large land animals, one might imagine the possibility of long overland travel. An elephant, for instance, is physically capable of walking considerable distances. Yet even here the practical difficulties are immense. A journey of several thousand kilometers would require sustained access to food, water, and suitable climate conditions. The terrain would vary from deserts to mountains to dense forests. Predation, injury, disease, and simple exhaustion would impose severe limits. If such migrations were universal across species, they would represent an ecological upheaval of extraordinary magnitude.

The difficulties multiply when one considers small, fragile, or slow-moving animals. Creatures such as mice, reptiles, amphibians, or tortoises have limited daily ranges and are highly vulnerable to environmental hazards. A mouse cannot realistically traverse continents; a turtle cannot cross deserts; many amphibians cannot survive outside narrow moisture and temperature bands. Even modest geographical barriers — rivers, mountain ranges, climatic zones — become insurmountable obstacles. The time required would exceed not merely months or years, but the natural lifespan of many species.

Birds introduce another layer of complexity. While some species migrate over long distances, most do so along established ecological routes shaped by climate and seasonal resources. A universal redirection of all bird species toward a single destination would imply a breakdown of normal behavioral patterns on a global scale. The energetic demands alone would be immense, particularly for small birds with high metabolic rates.

The problem becomes still more acute when geography is considered. Many terrestrial species inhabit regions separated by vast oceans. Australia, the Americas, Madagascar, and countless large and small islands host distinctive faunas shaped by long evolutionary isolation. For these animals, no continuous land path to the ark would have existed. Swimming thousands of kilometers across open ocean is biologically impossible for most terrestrial mammals, reptiles, and small

vertebrates. Saltwater exposure, exhaustion, lack of rest, and predation render such journeys inconceivable. Even floating vegetation rafts, sometimes invoked in biogeography over geological timescales, cannot account for synchronized, deliberate migrations within a single generation.

Nor do the difficulties end with arrival. Upon leaving the ark after the Flood, every species would have faced the reverse problem: a second global migration, this time outward. Animals would have to disperse across continents, reoccupy ecological niches, and somehow return to the specific habitats suited to their survival. Specialized species — those dependent on precise climates, vegetation, prey, or symbiotic relationships — would be especially constrained. Deserts, tropical forests, polar environments, isolated islands, and remote continents would all need to be repopulated. Once again, vast oceans would intervene. The narrative thus presupposes not one extraordinary biological redistribution, but two.

Modern biogeography sharpens the difficulty further. Entire regions of the world possess highly distinctive animal communities that are not random collections, but coherent evolutionary assemblages. Australia offers the clearest example. Its mammals are dominated by marsupials — kangaroos, wallabies, koalas — found nowhere else in the world in comparable form. South America historically displayed its own characteristic fauna, while remote islands such as Madagascar host extraordinary concentrations of endemic species. These patterns reflect deep evolutionary separation over immense timescales. A recent global convergence and dispersal of all terrestrial animals would tend to blur such distinctions, producing widespread mixing of faunas across continents. Yet the biological world instead displays strong, stable geographical structure.

Furthermore, even if one assumes that the problem of feeding the animals during the Flood itself was resolved by miraculous means, a further and often overlooked difficulty immediately arises after the waters recede. The returning animals would encounter landscapes stripped of stable ecosystems. Herbivores would find little or no vegetation, since prolonged submersion, sediment deposition, salinity changes, and mechanical destruction would have literally *devastated* plant life across continents. Carnivores would fare no better. With only a minimal number of surviving animal pairs dispersed over vast territories, viable prey populations would be effectively *nonexistent*. Predator–prey systems require large, reproductively stable populations; they cannot function when both predator and prey begin from near-zero densities. Yet the narrative is silent on any post-Flood ecological restoration. If extraordinary intervention were required to sustain animal life during the voyage, similar intervention would appear no less necessary once the animals disembarked into a biologically impoverished world.

In essence, the story requires a universal convergence of species followed by a universal dispersal, both occurring within a narrow historical window, and both somehow preserving the intricate regional patterns observed today. Entire ecosystems would first have been emptied and then refilled, continents repeatedly traversed, climatic barriers ignored, and oceans overcome. Such a pair of worldwide redistributions would themselves constitute biological events of unparalleled scale, leaving clear ecological, genetic, and geographical signatures. Yet the modern distribution of species, and the evolutionary histories it encodes, show no trace of such a recent, global relocation.

Seen in this light, the difficulty is not merely logistical but structural. The narrative presupposes two global biological redistributions — first a universal migration toward a single point, then a universal dispersal outward — all within a brief historical interval (a year or so), and all without disturbing the deep geographical patterns that define the living world. Continents, climates, ecological barriers, and oceans would somehow have been traversed twice, yet the distinctive regional character of Earth's fauna would remain intact. Such a scenario is not simply improbable; it runs counter to the fundamental biogeographical structure of life on Earth.

A truly global flood of the magnitude described would not simply recede and leave behind a habitable world. Prolonged submergence under turbulent waters capable of reshaping landscapes would strip away topsoil, bury continents under sterile marine sediments, and destroy forests, grasslands, and seed banks worldwide. Saltwater saturation would render newly exposed soils saline and infertile, requiring prolonged rainfall and drainage over many years — if not decades — to restore agricultural viability. Freshwater ecosystems would collapse under salt contamination and sediment overload, necessitating slow hydrological stabilization and biological recolonization. Marine systems, too, would suffer massive disruption of reefs, coastal habitats, and food webs. The re-establishment of stable soils, functioning freshwater networks, mature forests, and balanced climatic cycles would plausibly require centuries and in many cases millennia. The rapid return to ordinary life presupposed by the narrative is therefore ecologically difficult to reconcile with the scale of devastation implied.

We must also consider **aquatic animals** — the various creatures inhabiting oceans, seas, rivers, and lakes. The Torah narrative makes no mention of these animals, apparently implying that they were not endangered by the Flood and that no specimens needed to be preserved in the ark. Some rabbinic sources briefly address the topic, noting that fish and other aquatic life were left to their own devices. Far from being unaffected, however, these creatures would have been entirely

overwhelmed by a global deluge. Mixing and churning of all waters, destruction of natural habitats, and massive environmental disruption would have placed virtually every species at extreme risk. Saltwater and freshwater species, shallow-water dwellers, deep-ocean inhabitants, great whales, and microscopic plankton and krill alike would have faced incompatible conditions, leading in many cases to mass mortality.

The biological challenges facing aquatic life in a global flood would be immense. Ocean and freshwater habitats are highly specialized. Many species are adapted to narrow ranges of salinity, temperature, pressure, oxygen levels, and light conditions. Freshwater fish, for example, cannot tolerate high salinity; saltwater species cannot survive in freshwater for extended periods. Even within a single environment, species are finely tuned to specific depths, flow rates, and substrate conditions. Catastrophic mixing of oceans, rivers, and lakes would have homogenized salinity and temperature profiles, destroyed structural habitats such as coral reefs, riverbeds, and underwater vegetation, and suspended massive quantities of sediment. Many species would have been smothered, starved, or physiologically unable to cope.

Large marine animals, such as whales and sharks, face particular constraints. Baleen whales, for example, filter-feed on dense swarms of krill that form the base of their food chains. A sudden worldwide upheaval of ocean waters would disrupt food availability, temperature gradients, and migratory routes. Smaller organisms like krill and plankton, while abundant, are highly sensitive to changes in water chemistry, temperature, and current patterns. Disruption of these populations would cascade through the food web, affecting larger predators, from fish to whales.

Freshwater fish, amphibians, and other aquatic species in rivers and lakes would also face fatal challenges. A global flood would erode riverbanks, scour lake beds, introduce enormous sediment loads, and change water chemistry dramatically. Many species cannot tolerate sudden turbidity, oxygen depletion, or altered temperatures; shallow-water and bottom-dwelling species are particularly vulnerable. Even if some survived temporarily in isolated pockets of water, recolonization of original habitats post-Flood would be biologically implausible without human intervention or miraculous guidance.

From a quantitative standpoint, the scale of the problem is staggering. The total biomass of all fish and other aquatic vertebrates today is roughly 0.7–1 billion metric tons, concentrated in oceans (~90%) and freshwater habitats (~10%). Adding the vast numbers of plankton, krill, and other small invertebrates — likely 10 billion metric tons or more globally — illustrates the enormous energy flow sustaining aquatic ecosystems. Many fish consume 1–5% of their body weight

daily, while baleen whales require millions of tons of krill per year. Even a temporary disruption of this food supply would have catastrophic consequences for marine and freshwater species alike.

Unlike terrestrial animals, aquatic species cannot migrate to alternative habitats. Fish cannot move across continents; plankton cannot relocate from deep ocean to freshwater lakes; and specialized species cannot adapt quickly to sudden environmental extremes. The catastrophic mixing of saltwater and freshwater, scouring of riverbeds and lakes, destruction of coral reefs and vegetation, and massive sedimentation would have made survival nearly impossible. Depth-sensitive species would be exposed to incompatible pressures, temperatures, and light levels, while shallow-water dwellers could be buried or swept away. Moreover, as the floodwaters receded, vast numbers of aquatic organisms would inevitably have been stranded on newly exposed land surfaces, where survival would be impossible. In effect, a global flood would have produced an unsustainable ecological collapse across all aquatic environments, from the largest whales to the smallest plankton.

Rabbinic commentary on this topic is sparse. Some sources suggest that fish were spared because they already existed ‘in the waters’ and did not require preservation in aquariums aboard the ark. Others implicitly note that no instructions were given to save aquatic species, unlike terrestrial animals. From a scientific perspective, however, the Flood would have been catastrophic for aquatic life, comparable to or exceeding the challenges faced by terrestrial species. Destruction of habitat, forced mixing of fresh and saltwater systems, and disruption of ecological niches would have rendered survival for most species impossible.

In short, aquatic species, far from being immune, would have faced lethal environmental conditions on a global scale. No ark, no artificial containment, and no natural migration pathways could have protected them. The magnitude of the biomass involved, the fragility of marine and freshwater ecosystems, and the complexity of food webs all point to an event of such catastrophic scale that survival across the full diversity of aquatic life is inconceivable.

Finally, we need to consider **vegetation**, on land and underwater. Here again, the Torah narrative seems to consider that plant life would somehow fend for itself during a global flood and come out of it unscathed. This is far from true, as the following account makes clear.

Vegetation, both on land and underwater, is another critical component of the biosphere that would have been profoundly affected by a global flood. The Torah narrative does not specify the preservation of plants, apparently assuming that they would somehow survive or recover afterward. Yet from a biological and ecological

standpoint, the idea that plant life could withstand such a cataclysm unscathed is highly implausible. Plants, unlike animals, cannot move to safety; they are anchored to the substrate and depend on specific soil conditions, water chemistry, and sunlight. A worldwide deluge would have uprooted, submerged, and buried vast tracts of terrestrial vegetation, while also smothering aquatic plants with suspended sediments and altering salinity and nutrient levels.

Terrestrial plants are highly sensitive to flooding. Even brief inundation can kill species not adapted to saturated soils, and global-scale flooding would eliminate nearly all normal soil structure, leach essential nutrients, and introduce extreme sediment deposition. Forests would be uprooted, grasslands buried, and agricultural crops completely destroyed. Seeds and dormant structures might survive in limited areas, but recolonization across continents within a short historical timeframe would be impossible without human assistance. Even hardy species such as mangroves, which tolerate high water levels and salt, could not survive the wholesale churning, sediment load, and mechanical destruction caused by a worldwide flood.

Underwater plants and algae face similar challenges. Freshwater macrophytes, riverine grasses, and algae in lakes depend on relatively stable light, nutrient, and chemical conditions. Sudden, massive sedimentation, mixing of fresh and salt waters, and scouring of lake and river beds would decimate these populations. In oceans, seagrass beds, kelp forests, and other benthic vegetation would be buried or displaced by the enormous turbulence and suspended particulate matter. Disruption of these primary producers would ripple through aquatic food chains, affecting fish, invertebrates, and larger predators, just as the collapse of plankton and krill populations would undermine whales.

From a quantitative perspective, the terrestrial plant biomass alone is enormous. Estimates suggest that the total global above-ground plant biomass is roughly 450–500 billion metric tons, with an additional 10–20 billion metric tons in aquatic plants. Much of this biomass is concentrated in forests, tropical and temperate, with roots, trunks, and canopies finely tuned to their ecological niches. Even partial destruction of these ecosystems would constitute a massive ecological collapse, with consequences for carbon storage, soil retention, oxygen production, and the entire web of herbivorous and omnivorous life that depends on plants for sustenance.

In short, the notion that vegetation would survive a global flood unscathed is biologically untenable. The combination of uprooting, burial, sedimentation, altered salinity, and nutrient disruption would have decimated both terrestrial and aquatic plants. Recovery would require millennia, not decades, and the wholesale

destruction implied by a worldwide flood is incompatible with the continuity of plant life observed in the fossil record and modern ecosystems. Just as terrestrial and aquatic animals would have faced near-insurmountable challenges, so too would plants — the very foundation of the biosphere.

Vegetation, though silent and immobile, forms the backbone of life on Earth. A global flood would have destroyed ecosystems, obliterated habitats, and disrupted food chains from the ground up. The Torah narrative, by not addressing plant survival, implicitly assumes a resilience that is ecologically impossible. Scientific evaluation shows that plant life, both on land and underwater, would have suffered catastrophic loss, reinforcing the broader conclusion that a worldwide flood, as described in the Torah, presents insurmountable challenges to the survival of life — both animal and vegetal — on planet Earth.

In conclusion, taken together, the biological considerations outlined above — the impossibility of maintaining the genetic diversity and daily needs of humans and terrestrial animals, the logistical and ecological collapse implied for aquatic species, and the catastrophic destruction of both terrestrial and underwater vegetation — render the traditional narrative of a global flood utterly implausible. Feeding, watering, and caring for hundreds of thousands of terrestrial species, ensuring survival of aquatic ecosystems, and preserving plant life across continents and oceans would have required an unimaginable convergence of biological, ecological, and logistical miracles. Even granting generous assumptions and massive Divine intervention, the scale, complexity, and interdependence of Earth's living systems make a literal, single-year, worldwide deluge inconsistent with what is known from modern science about genetics, ecology, and environmental stability.

4. The rainbow after the deluge

One further element in the global Flood narrative calls for examination: the rainbow described in Genesis 9:8-17, which I quote partly here:

> **9:**9 'As for Me, behold, I establish My covenant with you, and with your seed after you; 10 and with every living creature that is with you, the fowl, the cattle, and every beast of the earth with you; of all that go out of the ark, even every beast of the earth. 11 And I will establish My covenant with you; neither shall all flesh be cut off any more by the waters of the flood; neither shall there any more be a flood to destroy the earth.'… 13 I have set My bow in the cloud, and it shall be for a token of a covenant

> between Me and the earth. 14 And it shall come to pass, when I bring clouds over the earth, and the bow is seen in the cloud, 15 that I will remember My covenant.'…

There are varying opinions regarding the significance of this Torah passage. The most common interpretation of the "bow in the cloud" is that this expression refers to the rainbow we ordinarily perceive after rainfall when the sun shines through retreating clouds. The rainbow is then understood as a sign — perhaps reminding us of God's kindness in preserving life on earth. If so, the question arises whether the passage means that the rainbow did not exist before the Flood, or whether it existed previously but acquired its symbolic significance only afterward. Clearly, if the text is read in the latter way, it presents no difficulty from a scientific perspective; if read in the former way, however, it presents a serious one.

A rainbow is not an isolated object that could be introduced into nature at some late historical stage. It is a necessary optical consequence of the interaction between sunlight and water droplets suspended in the atmosphere. Whenever those two conditions coexist under the appropriate geometry, a rainbow will appear. The physical process is well understood. Sunlight entering a spherical raindrop is refracted (that is, bent) as it passes from air into water. Part of that light is then reflected internally from the back surface of the droplet and refracted again as it exits. Because different wavelengths of light are refracted by slightly different amounts, white sunlight is dispersed into its constituent colors. Crucially, owing to the geometry of refraction within spherical droplets, the emerging light is concentrated around a specific angle — approximately 42 degrees for red light relative to the direction opposite the sun. For an observer standing with the sun behind and rain before him, this concentration produces the familiar circular arc of the rainbow.

The rainbow is therefore not a material object located "in" the clouds. It is an observer-dependent optical phenomenon governed by stable and mathematically describable laws of refraction, reflection, and dispersion. So long as sunlight and atmospheric water droplets have coexisted — as they must have since the earliest stages of Earth's history — rainbows would inevitably have formed whenever rain fell opposite the sun and an observer was suitably positioned. They are predictable manifestations of the enduring physical properties of light and water. This being so, the suggestion that the rainbow came into being only a few thousand years ago, following a global flood, is incompatible with what we know of optics. Light and water long predate any such proposed historical event; and given their immutable

physical characteristics, the formation of rainbows would have been unavoidable from the first occurrence of rain illuminated by sunlight.

In view of these considerations, we may say with confidence that the text cannot plausibly be taken to imply that the rainbow was introduced as a new natural phenomenon only after the Flood. The only interpretation consistent with the known laws of physics is that the rainbow existed before the Flood but acquired a special symbolic significance afterward. Read in this way, the narrative does not conflict with the scientific account of rainbow formation. Whether that interpretation reflects the original intention of the author is, of course, a matter of textual judgment[51]. What can be affirmed with certainty is that the rainbow itself is not a late addition to nature, but an inevitable consequence of the world's optical structure.

Within the Jewish exegetical tradition, several views have been advanced concerning the ontological status of the post-Flood rainbow. A number of commentators, including Abarbanel, Malbim, and Ibn Ezra, maintain that the rainbow as a meteorological phenomenon did not exist prior to the Flood but was introduced into nature afterward, whether through a change in the atmosphere or an intensification of solar light. Most commentators, however, including Saadia Gaon, Rashi, Ramban, Radak, Gersonides, and Samson Raphael Hirsch, hold that the rainbow existed from the beginning of creation and merely acquired a covenantal significance after the Flood. A third approach, suggested by Rabbeinu Bachya, leaves the matter more open, allowing that the text may be read either as describing a new creation or as designating an already existing natural phenomenon as a sign of the covenant.

My own opinion is different from those traditional ones. In this Torah passage, there is talk of a "covenant" (*berit*). Yet as far as I can see it is a unilateral covenant, with no counterpart requested of humanity (such as improved behavior). God promises *unconditionally* to abstain from ever bringing about a flood capable of destroying all life on earth, and He appoints the "bow in the cloud" (*keshet beanan*) as a "token" (*ot*), to remind himself of that covenant. Note that He presents the "bow in the cloud" only as a reminder *to himself*; nowhere does He say that it is to serve as a reminder to humanity. This is puzzling for two reasons: since God does not forget anything, He surely does not need reminders; only humans would need reminding, but only if the reminder served some purpose and none is here mentioned. The most natural reading of the text suggests that this "bow in the cloud" refers to the familiar rainbow seen during or after rain; but it could equally

51 According to R. E. Friedman, the author was the priestly source P.

well refer to some purely mystical phenomenon perceptible only to God, in which case He could simply be sharing information with us as a revelation of His merciful intention (presumably, even if humanity sins greatly again[52]).

5. Comparable narratives

We can furthermore look into **similar flood stories** in other cultures and periods, since the biblical flood story is often claimed to have been derived from the Gilgamesh epic. Clearly, there are some probable influences across space and time, but some stories seem quite independent. In any case, the existence of many and various great flood stories does not prove the historicity of any world flood narrative.

The earliest flood traditions appear in ancient Mesopotamia. Sumerian sources such as the *Eridu Genesis* tell of a great deluge and a hero named Ziusudra; although the surviving tablets are fragmentary, they reflect an older tradition from the late third millennium BCE or early second millennium BCE that depicts a flood sent by the gods and a lone survivor who preserves life. Building on these older Sumerian motifs, the Atra-Hasis Epic, an Akkadian text recorded in various versions including Old Babylonian copies from around the mid-18th century BCE, presents a detailed deluge story in which the wise hero Atra-Hasis builds a boat to survive a divine flood. Later, the *Epic of Gilgamesh* incorporates a flood episode featuring Utnapishtim, drawing on earlier Mesopotamian material. The standard Akkadian version of the epic was composed around the late second to early first millennium BCE (roughly 1300–1000 BCE in surviving tablets), though the flood story itself reflects older traditions preserved in works such as the *Atra-Hasis* epic and even earlier Sumerian flood narratives.

In ancient China, flood legends such as the Great Flood of Gun-Yu are rooted in mythological traditions that were later written down; these are traditionally placed in the third millennium BCE during the reign of Emperor Yao and preserved in later historical and mythographic sources that recount heroic efforts to control extensive flooding.

The Hebrew Bible's Flood narrative in Genesis was written down well after the Mesopotamian epics. While Jewish tradition attributes the authorship of Genesis to Moses in the second millennium BCE (often around the time of the wilderness wanderings or shortly thereafter, roughly 15th–13th century BCE in traditional views), modern biblical scholarship generally regards the composition and final

52 See also Genesis 8:21-22.

redaction of Genesis as occurring much later, with multiple sources compiled and edited over centuries and the final form taking shape after the Babylonian Exile in the first millennium BCE.

In the Indian subcontinent, flood traditions involving Manu and a divine fish rescuer (*Matsya*) are found in the *Shatapatha Brahmana* of the Vedic corpus. These texts were composed and transmitted over many centuries, with the *Shatapatha Brahmana* itself dating to around the 7th–6th century BCE (with older oral elements likely predating the written versions) and later elaborations in the *Matsya Purana* and other Purāṇic works.

By the first millennium BCE, flood motifs had also entered Greek myth, such as the story of Deucalion and Pyrrha, which appears in classical sources and reflects a later literary tradition of a world-destroying flood from the Mediterranean world, often influenced by contact with older Near Eastern narratives.

Let us compare **the Gilgamesh flood story** with the biblical one.

The *Epic of Gilgamesh* (Tablet XI) recounts a great flood sent by the gods to destroy humanity, with Utnapishtim as the sole survivor. He is warned to build a large boat to save his family, livestock, and "seed of all living creatures." The rain lasts for six days and six nights, and the floodwaters rise to cover the mountains, eventually reaching Mount Nisir in modern Iraq, estimated at roughly 1,500 meters in elevation. To determine whether the waters have receded, Utnapishtim releases a sequence of birds: first a dove, then a swallow, and finally a raven. The birds' failure or success to find dry land signals the gradual withdrawal of the waters. The vessel ultimately comes to rest atop Mount Nisir after the rain stops and the waters drain over several days. The narrative is vivid in detailing the construction of the boat, the duration of the storm, the animals saved, and the use of birds to track the receding floodwaters.

The Hebrew Bible's account of Noah in Genesis shares many of these structural elements. God warns Noah, a righteous man, to build an ark and preserve his family and representative animals. The rain lasts forty days and forty nights, much longer than in Gilgamesh, and the waters rise to cover the highest mountains — roughly 8,844 meters above sea level in the Everest scenario, or about 5,144 meters above it in the Mount Ararat one, where the ark eventually rests. Noah also releases birds to check for dry land: first a raven, which flies back and forth, then a dove, sent repeatedly, until it finds dry ground. The waters gradually recede over 175 days, much longer than in the Gilgamesh story, before the ark comes to rest on Mount Ararat. Genesis emphasizes exact durations, high-water levels, and mountain resting places, intensifying the scale of the catastrophe compared with Gilgamesh.

A quantitative comparison illustrates the difference in magnitude. The Gilgamesh flood, rising to 1,500 meters over six days, would have required roughly 765 million cubic kilometers of water. In contrast, the Genesis flood covering Mount Ararat would require about 2,625 million cubic kilometers of water, or about 4,517 million cubic kilometers if it reached the height of Everest. Drainage rates differ accordingly: in Gilgamesh, the waters receded over a matter of days; in Genesis, the floodwaters retreated over 175 days. Both stories feature boats as instruments of survival, divine warning, preservation of species, birds used to test for land, and mountains as final resting places. The Hebrew account expands the catastrophe to a global level, amplifying the physical and moral drama.

The similarities between the two narratives point to shared Near Eastern flood traditions. Yet they differ sharply. Genesis describes a global flood with longer rain and slower receding waters, while Gilgamesh depicts an apparently more localized deluge with shorter rain and lower water levels. In Gilgamesh, the "seed (or offspring) of all living creatures," possibly referring to plants or more generally all life, is saved, whereas Genesis preserves representatives of each "kind" of animal, specifying males and females. These contrasts show how the two stories share a common flood motif but diverge in what life is preserved and how the deluge is framed.

It seems very likely that the Genesis flood story was based on the Gilgamesh one.

5. THE TOWER OF BABEL

1. The Torah narrative

The course of world events following the great flood is spelled out in Genesis 8-11[53]. The following are some of the passages of interest to us because of their focus on physical claims:

> **8:**13 And it came to pass in the six hundred and first year [of Noah's life]…. 14 And in the second month, on the seven and twentieth day of the month…. 15 And God spoke unto Noah, saying: 16 'Go forth from the ark, thou, and thy wife, and thy sons, and thy sons' wives with thee…. 18 And Noah went forth, and his sons, and his wife, and his sons' wives with him;
>
> **9:**18 And the sons of Noah, that went forth from the ark, were Shem, and Ham, and Japheth…. 19 These three were the sons of Noah, and of these was the whole earth overspread…. 28 And Noah lived after the flood three hundred and fifty years. 29 And all the days of Noah were nine hundred and fifty years; and he died.
>
> **10:**1 Now these are the generations of the sons of Noah: Shem, Ham, and Japheth; and unto them were sons born after the flood. 2 The sons of Japheth…. 5 Of these were the isles of the nations divided in their lands, every one after his tongue, after their families, in their nations. 6 And the sons of Ham…. 20 These are the sons of Ham, after their families, after their tongues, in their lands, in their nations. 21 And unto Shem, the father of all the children of Eber, the elder brother of Japheth, to him also were children born. 22 The sons of Shem…. 31 These are the sons of Shem, after their families, after their tongues, in their lands, after their nations. 32 These are the families of the sons of Noah, after their generations, in their nations; and of these were the nations divided in the earth after the flood.
>
> **11:**1 And the whole earth was of one language and of one speech. 2 And it came to pass, as they journeyed east, that they found a plain in the land of Shinar; and they dwelt there…. 6 And Hashem said: 'Behold, they are one

53 According to R. E. Friedman, these chapters were composed or redacted J, P, RJE, and Other.

> people, and they have all one language…. 7 Come, let us go down, and there confound their language, that they may not understand one another's speech.' 8 So Hashem scattered them abroad from thence upon the face of all the earth…. 10 These are the generations of Shem. Shem was a hundred years old, and begot Arpachshad two years after the flood. 11 And Shem lived after he begot Arpachshad five hundred years, and begot sons and daughters….

These indicate that after the Flood — which wiped out most life on and above Earth — only eight humans remained: Noah, his three sons (Shem, Ham, Japheth), and their wives, plus pairs of every terrestrial and airborne animal species. The Flood ended in 1657 AM (c. 2105 BCE), when Noah was 601 years old and Shem 98. All post-Flood nations descended exclusively from Noah's three sons (with no record of further children from Noah). While Shem's and his descendants' ages are biblically listed (Genesis 11:10–17), those of Japheth, Ham, and their lines are not. According to *Seder Olam Rabbah*, the Tower of Babel events occurred in 1996 AM (c. 1764 BCE) — 340 years after the Flood's onset — calculated by summing fatherhood ages from Shem to Peleg's era (because Genesis 10:25 states "in his days the earth was divided"). Until the Tower of Babel incident, Noah's descendants stayed together in unity and spoke the same language; thereafter, they were widely dispersed across the world and no longer shared a common tongue.

2. Critique of the Torah narrative

The notion that Noah's three sons and their wives — who, together with Noah and his wife, were the only survivors of the Flood roughly 4,130 years ago — were the ancestors of all subsequent humanity is, as we have already explained, highly implausible from the perspective of modern genetic science. *A bottleneck of six individuals a few thousand years ago could not possibly give rise to a viable population of roughly eight billion people today.* So, the Torah narrative that all humanity is descended from Noah's family is simply incredible and can, *on this basis alone*, be viewed as a naïve fable.

But we can push the critique further by considering what the population would have been at the time of the Tower of Babel incident, traditionally calculated to have taken place about 340 years after the Flood.

Modern historical demography estimates the world population around 1760 BCE at roughly 100–110 million people, concentrated in a few core regions. East Asia (Yellow River valley) and South Asia (Indus Valley and successor cultures) each had about 15–20 million, the Near East (Mesopotamia, Anatolia, Levant) roughly

10–12 million, and Egypt 5–6 million. Smaller agricultural populations of 5–7 million existed around the Mediterranean and in Central Asia, the Caucasus, and Iran, while much of the world — sub-Saharan Africa, the Americas, Australia, Oceania, and northern Eurasia — remained sparsely populated.

To reach a population of roughly 100 million people in only 340 years, the three sons of Noah and their wives would require an average annual growth rate of approximately 4.9 percent, or a doubling of the population roughly every fourteen years. Such growth is biologically unprecedented and far beyond anything observed in pre-modern societies, where growth rates were typically below 0.5 percent per year, and even exceeds the most rapid expansions recorded in modern times, which rarely surpassed 2–3 percent annually, though only briefly. Sustaining a 4.9 percent growth rate over more than three centuries would require each couple to have a very large number of surviving children every generation, with negligible mortality, and for all groups to remain continuously fertile — conditions that have never existed historically. For these reasons, such a demographic scenario is essentially impossible.

The stark contrast between the slow, localized growth reflected in the historical and archaeological record and the astronomical expansion implied by the Torah narrative underscores *the implausibility of a literal demographic reading of the Flood and Babel accounts*.

The author of the Tower of Babel narrative was obviously unaware of these biological and demographic constraints. There are additionally many historical inaccuracies in the biblical story.

Genesis 10 lists seventy descendants of Noah, traditionally understood as the ancestors of all the nations of the world. Of these, fourteen descend from Japheth (seven sons and seven grandsons), thirty from Ham (four sons, twenty-three grandsons, and two great-grandsons), and twenty-six from Shem (five sons, five grandsons, one great-grandson, two in the fourth generation, and thirteen in the fifth generation through Joktan). The genealogy is thus uneven in depth: the line of Japheth extends only to the second generation, the line of Ham to the third, while the line of Shem continues to the fifth.

The traditional total of seventy nations is therefore not a genuine genealogical reckoning but a schematic enumeration. If the aim were to count nations by descent, they would have to be reckoned at the same generational level. One might, for example, count the nations as descending from Noah himself, or from his three sons, or from the sixteen sons of these sons, and so forth. But the given list instead mixes sons, grandsons, great-grandsons, and still later descendants in a single tally, a procedure that inevitably counts different branches of the same family at different

generational depths and thus precludes any strictly genealogical interpretation of the total.

I suspect that the author of this text imagined that the seventy men (plus their wives) listed as the ancestors of all humanity were the very people who set about building the Tower of Babel. This supposition would explain why individuals of different generational depths are lumped together in the genealogical list.

Already in antiquity, Jewish scholars attempted to identify the names listed in Genesis 10 with known peoples and regions. The earliest systematic effort is found in Flavius Josephus (*Antiquities of the Jews* I.6.1–4, first century CE), and similar identifications appear in the Aramaic Targums (especially *Targum Jonathan* and *Targum Pseudo-Jonathan*), as well as in rabbinic literature such as the Babylonian Talmud (Pesachim 87b) and Midrash Genesis Rabbah. Medieval commentators including Rashi, Ibn Ezra, and Nachmanides also transmitted or elaborated these associations, often drawing upon Josephus and earlier traditions.

Among the descendants of Japheth (Genesis 10:2–5), traditional identifications commonly associate Gomer with the Cimmerians of the northern Black Sea region, Magog with the Scythians, Madai with the Medes, and Javan with the Ionians or Greeks. Tubal and Meshech are linked with peoples of Anatolia (often identified with the Tibareni and Mushki), while Tiras is commonly connected with the Thracians. The sons of Gomer — Ashkenaz, Riphath, and Togarmah — were associated with northern peoples; Ashkenaz was later connected with regions of Germany, though in earlier sources it referred to Scythian territories. From Javan descended Elishah, often linked with the Aeolians or Cypriots, Tarshish, sometimes identified with Tartessos in Spain or Tarsus, Kittim, generally associated with Cyprus (and later with the Romans), and Dodanim or Rodanim, identified with Rhodes.

The descendants of Ham (Genesis 10:6–20) were traditionally connected with Africa and the Levant. Cush was associated with Ethiopia or Nubia, Mizraim with Egypt, Put with Libya, and Canaan with the peoples of the Levant and Phoenicia. The sons of Cush — Seba, Havilah, Sabtah, Raamah, and Sabteca — were often placed in regions of Arabia and northeast Africa. From Raamah came Sheba and Dedan, known from South Arabian trade networks. The figure of Nimrod, also associated with Cush, was traditionally regarded as a mighty ruler and the founder of Mesopotamian cities such as Babel, Erech, and Akkad. The descendants of Mizraim were identified with various Libyan or Egyptian groups: Ludim, Anamim, and Lehabim with Libyan tribes; Naphtuhim with peoples of the Nile delta; Pathrusim with Upper Egyptians; Casluhim with Libyan regions; and Caphtorim with Crete, often linked with the origin of the Philistines. From Canaan descended

a number of peoples known from the biblical and archaeological record: Sidon (the Phoenician city), Heth (the Hittites), Jebusites, Amorites, Girgashites, and Hivites, as well as the Arkites, Sinites, Arvadites, Zemarites, and Hamathites, all associated with locations in Syria and Lebanon.

The descendants of Shem (Genesis 10:21–31) were linked primarily with peoples of Mesopotamia and the Near East. Elam was identified with the Elamites of southwestern Iran, Asshur with the Assyrians, Arphaxad with the Chaldeans, Lud with the Lydians of Anatolia, and Aram with the Arameans of Syria. The sons of Aram — Uz, Hul, Gether, and Mash — were associated with regions of Syria, Armenia, or northern Mesopotamia. From Arphaxad came Shelah and Eber, the latter traditionally regarded as the eponymous ancestor of the Hebrews. The descendants of Joktan, including Almodad, Sheleph, Hazarmaveth, Ophir, Sheba, Havilah, and Jobab, were generally associated with tribes of southern Arabia, reflecting knowledge of ancient Arabian trade networks.

Clearly, although ancient Jewish interpreters thought their listing of the peoples of the world to be exhaustive, they were in fact far from correct. The author(s) of the Torah, and subsequent commentators in all eras until modern times, could obviously speak only of nations known or vaguely heard of in their own places and times. They could not possibly have known of peoples living very far away from them overland, or overseas on continents or islands that had not yet been discovered, which were equally unknown to the peoples around them, or of whom they had not yet heard because of their relative cultural isolation. That anyone today can doubt or deny this necessary past ignorance in traditional sources, in a last-ditch effort to preserve the dogma of the omniscience of the Torah, can only be characterized as lamentable.

Babylon, one of the most famous cities of the ancient world, was located in Mesopotamia on the fertile alluvial plain of the Euphrates, generally identified with the biblical plain of Shinar. The city likely began as a small Akkadian settlement during the early third millennium BCE, but its first significant urban development came under the Amorite rulers of the early second millennium BCE. Sumu-abum, around 1894 BCE, is traditionally regarded as the founder of the first Babylonian dynasty, and the city reached its height under Hammurabi, who reigned from 1792 to 1750 BCE. *Interestingly, his reign encompasses the traditional date of c. 1764 BCE for the Tower of Babel story.*

Babylon's location made it ideal as a center for agriculture, trade, and administration, connecting the northern and southern regions of Mesopotamia. The name "Babylon" derives from the Akkadian *Bāb-ilim*, meaning "Gate of God" or "Gate of the Gods." While the biblical name "Babel" may play on the Hebrew verb

balal, "to confuse," *historically the city's name long predates the story of the Tower of Babel*.

The famous biblical narrative may reflect a distant memory of the city's monumental architecture and cultural prominence, rather than a literal post-Flood construction. Central to Babylonian religious and civic life were the ziggurats, which were massive, terraced platforms with temples atop them. These structures, which first appeared in Sumer around 3000 BCE, were built as symbolic mountains connecting heaven and earth, with the temple on top serving as the dwelling place of the city's deity. Ziggurats were constructed throughout Mesopotamia, evolving over centuries in both form and scale.

The most iconic example in Babylon was the ziggurat called Etemenanki, meaning the "Temple of the Foundation of Heaven and Earth." The monument's name suggests that, historically, in their religious and social context, ziggurats symbolized human ambition to connect with what they thought of as higher realms. This structure may well have inspired the biblical image of the Tower of Babel, since in the biblical story the tower's aim was to "*make a name for ourselves and build a city with its top in heaven*" (Genesis 11:4). In the narrative, however, this ambition is not depicted positively; God apparently disapproves of such human velleities and acts decisively to prevent their fruition.

Beyond the architectural symbolism, the story's theme of linguistic confusion and the dispersion of people may encode collective memory of the real diversity of Mesopotamia: by the second millennium BCE, the region hosted multiple ethnic and linguistic groups — Sumerians, Akkadians, Amorites, Hurrians, and others — whose coexistence presumably made coordination across cities and regions complex. In this sense, the narrative preserves the social and cultural realities of early Mesopotamian urban life.

We can infer from the ziggurats that the Babylonians were, as the Torah account indirectly acknowledges, already a people engaged with spirituality and the divine. This represents a significant achievement for humanity, marking a clear advance from earlier, likely more animistic, levels of religious concern, even if many idolatrous or pagan elements remained in their thinking. It was in this civilizational and cultural cradle that the monotheistic faith of Abraham — later articulated and advocated by the Torah — eventually evolved. The Tower of Babel narrative should therefore be understood in context as an effort to delineate the emerging monotheistic vision from the earlier forms of religious practice.

According to traditional biblical chronology, Abraham was born in 1948 AM and received his Divine call at the age of seventy-five (Genesis 12:4); that is, in 2023 AM (about 1738 BCE). His call would thus have occurred roughly twenty-

seven years after the Babel incident, meaning that Abraham would have been about forty-eight years old at the time.

The Torah narrative gives the impression that all humanity was concentrated in Babylon when the city and its tower were being built, since it is only after that event that humanity is said to have been scattered across the world. If this assumption is taken literally, Abraham, like everyone else, would have been present in Babylon at the time; yet the Torah makes no mention of his presence there. Instead, he is said to have been born and lived in Ur and/or Haran[54], implying that these cities already existed before Babylon.

In fact, many cities predated Babylon. Urban life in the Near East developed gradually over many millennia, and numerous cities existed long before the time traditionally associated with the biblical patriarchs. Historians place the founding of Babylon at around 1894 BCE, but Jericho (in today's Israel) is thought to date from roughly 9000 BCE; Çatalhöyük (in central Anatolia) flourished about 7500–5700 BCE; Uruk (in southern Mesopotamia), often considered the first true "urban" city, developed around 4000 BCE; the Sumerian city of Ur was settled from about 3800 BCE; and Haran (in northern Mesopotamia) was already occupied by the third millennium BCE. These and many other settlements clearly predate Babylon by millennia. It follows that the Genesis narrative regarding Babel is not only internally inconsistent but also contradicted by historical and archaeological evidence.

Let us now test the Torah narrative further by examining how science and history account for human dispersal and the development of languages.

3. The story of human dispersal

As we have demonstrated above, the Torah narrative concerning the dispersal of humanity across the globe cannot be taken seriously. How, then, did humans come to be so widely distributed? The following is a concise scientific account of that process, drawing on the interdisciplinary fields of paleoanthropology, population

54 Biblical scholarship commonly distinguishes two traditions regarding Abraham's place of origin. One, reflected in the J and E sources, implies that Abraham's family homeland was Haran, from which he departed directly for Canaan (cf. Genesis 12:1–5). Another, associated with the P source, presents the family as originating in Ur of the Chaldeans, migrating first to Haran and only later continuing to Canaan (cf. Genesis 11:31–12:5). These two strands likely preserve different ancestral memories concerning the patriarch's earliest setting.

genetics, archaeology, and historical linguistics, which together provide insights into human origins, migrations, and the development of cultures and languages.

Modern humans (*Homo sapiens*) evolved in Africa roughly 300,000 years ago, according to fossil and genetic evidence. The earliest African populations were largely confined to the continent for tens of thousands of years, but by around 70,000–60,000 years ago, groups began to disperse into Eurasia, marking the 'Out-of-Africa' migration. This dispersal is supported by genetic studies (mitochondrial DNA, Y-chromosome lineages, and genome-wide analyses), which trace all non-African human populations to a relatively small number of founders leaving Africa during this period.[55]

The routes of early dispersal remain an area of active research and some debate. Two main pathways have been proposed: (a) The northern route through the Nile Valley and Sinai into the Levant, which allowed populations to move into the Middle East and onward into Europe and western Asia. (b) The southern coastal route across the Bab-el-Mandeb strait into Arabia, then along the coasts of the Indian Ocean into South and Southeast Asia, reaching Australia by 50,000–45,000 years ago.

From these initial expansions, humans gradually spread across Eurasia. In Europe, modern humans appeared around 45,000 years ago, overlapping with Neanderthals and later interbreeding with them, as shown by genomic evidence. East and Southeast Asia were colonized by 40,000–35,000 years ago, while the Pacific islands were settled much later, between 3,500 and 1,000 BCE, reflecting deliberate long-distance maritime migrations.

The Americas were the last major landmass to be settled. Genetic, archaeological, and paleoenvironmental evidence indicates that humans crossed Beringia from Siberia into Alaska no earlier than 20,000–18,000 years ago, with subsequent rapid expansion southward along the Pacific coast and interior, reaching the southern tip of South America by roughly 14,000 years ago.

Other species of the genus *Homo* also spread widely before modern humans. Neanderthals (*Homo neanderthalensis*) and Denisovans likely originated from African ancestors and migrated into Europe and Asia tens of thousands of years before *Homo sapiens*, with Neanderthals appearing in Europe as early as 400,000 years ago. These hominins adapted to local environments and developed their own tools and cultures, and in some regions they later encountered modern humans,

55 Although a few minority hypotheses have proposed regions such as East Asia as the origin of modern humans, the overwhelming scientific evidence — from fossils, genetics, and archaeology — supports Africa as the cradle of *Homo sapiens*.

leaving genetic traces that persist in present-day populations. Neanderthals became extinct around 40,000 years ago, while Denisovans disappeared roughly 50,000 years ago. Their migrations show that the dispersal of *Homo* species was a long-standing, multi-species process, setting the stage for the eventual global expansion of our own species.

Our understanding of human dispersal relies on multiple scientific methodologies, each with its strengths and limitations. Genetic studies trace lineages using mitochondrial DNA, Y-chromosome markers, and whole-genome sequencing, allowing researchers to reconstruct timelines and migration paths, though such dates depend on assumptions about mutation rates and calibration points. Archaeology provides independent evidence through radiocarbon dating, thermoluminescence, and stratigraphic analysis, but the material record is often fragmentary, particularly for coastal or submerged sites. Finally, paleoenvironmental reconstructions, including pollen analysis, isotopic studies, and faunal evidence, help identify regions where migration was ecologically feasible, though climate data are often uncertain at fine spatial and temporal scales. By integrating these approaches, scientists can develop a coherent, if necessarily approximate, picture of how *Homo sapiens* spread across the globe.

Despite these uncertainties, the overall picture is clear: modern humans originated in Africa, expanded into Eurasia by at least 60,000 years ago, reached Australia by 45,000 years ago, and ultimately colonized the Americas by 14,000 years ago, with migration influenced by climate, geography, and technological innovations such as seafaring and adaptable hunting strategies. Clearly, *humanity spread across the world long before the Tower of Babel story claims it did*.

4. The story of human languages

The Torah narrative concerning the origin and diversity of human languages is as inaccurate as that concerning human dispersal. Modern linguistic science shows that multiple languages had already evolved long before the traditional Tower of Babel incident some four thousand years ago, and they have continued to evolve ever since.

Human language is thought to have emerged with *Homo sapiens* roughly 100,000 years ago, though the precise timeline is debated and inferred from fossil evidence, the evolution of vocal anatomy, and genetic studies of speech-related genes. Over tens of thousands of years, languages have diverged and evolved, influenced by population isolation, migration, contact with other groups, and cultural innovations.

Today, linguists estimate that there are roughly 7,150 living languages worldwide, though about 40 percent are endangered, spoken by only small communities.

Languages are organized into families, each representing a set of tongues descended from a common historical ancestor. Major families include Indo-European (≈445 languages), which encompasses languages such as English, Spanish, Hindi, Russian, and Persian; Sino-Tibetan (≈450 languages), including Mandarin, Cantonese, and Burmese; and Niger-Congo (≈1,500 languages), spoken across much of sub-Saharan Africa and including Swahili, Yoruba, and Zulu. Other significant families include Afro-Asiatic (≈375 languages), containing Arabic, Hebrew, and Amharic; Austronesian (≈1,250 languages), spoken across the islands of the Pacific and Indian Oceans, including Malay, Tagalog, and Maori; and Dravidian (≈85 languages), including Tamil, Telugu, and Kannada. Numerous smaller families also exist, along with language isolates such as Basque or Burushaski, which have no known relatives.

The vast diversity of human languages results from a long, gradual process of divergence and evolution. Language families such as Afro-Asiatic, including the Semitic languages (arising in Northeast Africa and the Levant, perhaps 10000–8000 BCE); Indo-European (originating on the Pontic–Caspian Steppe, roughly 4500–2500 BCE); Sino-Tibetan (arising in northern China or the upper Yangtze region, roughly 4000–2500 BCE); and Niger-Congo (probably originating in West-Central Africa, roughly 3000–2500 BCE, though some reconstructions suggest deeper roots up to 7000 BCE) illustrate how languages have developed, split, and spread over millennia, shaped by migration, geographic separation, cultural contact, and incremental innovation. The emergence of multiple, distinct languages distributed across time and space was therefore a natural historical process, rather than a singular, instantaneous event.

There is no scientific basis for the belief, held by many Jewish commentators, that all the world's languages are derived from Hebrew. This belief rests on the Torah's account of Creation being written in Hebrew and on the undocumented supposition that Hebrew was the universal language of humanity until the Tower of Babel incident. A modern attempt to justify this view is Isaac E. Mozeson's *The Word: The Dictionary That Reveals the Hebrew Source of English*. However, despite its impressive scope and detail, the work has not been accepted by mainstream linguists (notably David L. Gold). Mozeson's thesis is rejected not because scholars dismiss the possibility of ancient linguistic connections, but because his method fails to meet the scientific standards used in historical linguistics.

Academic linguists invalidate Mozeson's thesis for several methodological reasons. His comparisons rely largely on superficial similarities between words,

which are statistically inevitable across unrelated languages. He does not demonstrate regular and systematic sound correspondences, the essential criterion used in historical linguistics to establish genetic relationships between languages. Many of the English words he derives from Hebrew already possess well-documented etymologies within the Indo-European language family, supported by historical attestations and intermediate forms. His argument rests almost entirely on vocabulary resemblances, while largely ignoring grammar, phonology, and other structural features that determine linguistic relationships. The thesis also contradicts the extensive comparative evidence underlying the established family-tree model of world languages, which identifies numerous independent language families. Finally, specialists have criticized the work for methodological looseness, including ad hoc phonetic shifts and selective use of evidence. For these reasons, linguists generally classify such approaches not as historical linguistics but as pseudo-comparative etymology.

From the standpoint of spoken language, Hebrew cannot be considered the earliest language. It is a member of the Semitic branch of the Afro-Asiatic language family and therefore a descendant of earlier reconstructed languages. Linguists posit a common ancestor, Proto-Semitic, spoken perhaps around 4000–3000 BCE, from which Hebrew, Aramaic, Arabic, Akkadian, and other Semitic languages later developed. Semitic itself forms only one branch of the broader Afro-Asiatic family, whose common ancestor (Proto-Afro-Asiatic) may date to roughly 10000–8000 BCE. Hebrew thus represents a comparatively late stage in a much older linguistic lineage. From the standpoint of written language, the situation is even clearer: several languages are attested in writing long before Hebrew appears in the historical record. Sumerian texts written in cuneiform are known from about 3100 BCE, and Egyptian hieroglyphic inscriptions from about 2600 BCE, whereas the earliest Hebrew inscriptions date only from roughly the 10th–9th centuries BCE[56]. In both its spoken ancestry and its written attestation, therefore, Hebrew cannot be regarded as the first human language.

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56 No securely identified Hebrew inscriptions earlier than roughly the 10th century BCE have been found so far. A few earlier fragments exist, but they are either written in Proto-Canaanite script or are linguistically uncertain, which is why scholars generally place the earliest clear Hebrew inscriptions in the 10th–9th centuries BCE. Significantly, these earliest texts are written in the so-called Paleo-Hebrew script, which is essentially a local variant of the Phoenician alphabet, itself descended from the earlier Proto-Canaanite writing system. The Hebrews therefore did not create a unique script from the outset but adopted and adapted an alphabet already used by neighboring Canaanite peoples — another indication that languages and their written forms develop gradually within broader cultural contexts.

It is thus reasonable to suppose that the Hebrew language has a history, one closely tied to the history of the Hebrew people. As that people gradually emerged from the broader Semitic world and became a distinct cultural and political group, their language likewise differentiated from its Proto-Semitic roots, developing its own identity. Like all languages, Hebrew continued to evolve over time together with the community that spoke and eventually wrote it. Even before the Jewish dispersion, however, Hebrew had begun to give way in everyday speech to Aramaic, which had become the common lingua franca of the Near East under the Assyrian, Babylonian, and Persian empires. During the Hellenistic and Roman periods many Jews also spoke Greek, the dominant international language of the eastern Mediterranean, while Latin remained largely confined to Roman administration and the military.

After the destruction of the Jewish polity and the dispersal of the Jewish people, Hebrew gradually ceased to function as an everyday spoken language, though it continued to be used extensively as a literary, scholarly, and liturgical language throughout the Jewish diaspora. When Jewish settlement in the land of Israel resumed in modern times, Hebrew was revived as a spoken language and once again entered a new phase of active linguistic development. Linguists commonly distinguish several historical stages in the language: biblical Hebrew (roughly 1200–200 BCE), the language of most of the Hebrew Bible; Rabbinic or Mishnaic Hebrew (about 200 BCE–500 CE), used in the Mishnah and early rabbinic literature; Medieval Hebrew (about 500–1800 CE), employed primarily as a literary, scholarly, and liturgical language throughout the Jewish diaspora; and Modern Hebrew, revived as a spoken language in the late nineteenth and twentieth centuries and now the principal language of the State of Israel.

Languages evolve through a variety of mechanisms. Sound change gradually shifts pronunciations across generations, while morphological change alters word structures and grammatical markers such as tense, case, or gender. Lexical change introduces new words via innovation or borrowing, and semantic shifts modify the meanings of existing words. Syntactic change reshapes sentence structure and word order, sometimes dramatically over millennia. Populations that remain isolated may see dialects diverge into fully distinct languages, while contact between groups can produce pidgins and creoles or facilitate borrowing and mixing. Because of these processes, all modern languages descend from earlier tongues, and many features can be traced back thousands of years.

From this perspective, the emergence of multiple, distinct languages is a gradual and inevitable outcome of human history, entirely independent of any single catastrophic event such as the biblical Tower of Babel miracle. The notion that all

languages could have suddenly split in a single moment is not only scientifically untenable but also cognitively and socially absurd: language develops over years within communities, transmitted and learned across generations, shaped by culture, interaction, and incremental innovation. A miraculous, instantaneous linguistic upheaval would have required *fundamental changes in the organization and functioning of neural cells in the brains of all individuals affected*.

Such a miracle would have required God to rewire the complex language systems of every human brain at once — the regions that understand meaning, construct sentences, produce speech sounds, store vocabulary, and coordinate memory and motor control. Normally, these abilities develop gradually over many years, shaped by social interaction, imitation, and repeated practice, as neural circuits are slowly strengthened and refined. Within each brain, language is encoded across networks of cortical neurons, with words and grammar stored in patterns of synaptic connections that are reinforced whenever recalled or used. Speech, comprehension, and memory emerge from a dynamic interplay between these circuits and supporting regions such as the hippocampus, basal ganglia, and cerebellum, allowing humans to retrieve, combine, and articulate language fluently. To endow every person with fully functional, distinct languages in a single instant would have required the simultaneous rewiring of billions of neural networks worldwide — a cognitive and biological impossibility.

Of course, God, the creator of the whole universe and of every human being, could conceivably readily perform such a miracle; but miracles are ordinarily not so massively intrusive and controlling in the mental functioning of large groups of people. One may well suppose that the author of this unlikely story did not realize the enormity of what he was imagining, just as the author of the global flood story overlooked the full implications of his sweeping scenario.

6. THE EXODUS AND WANDERING

1. The population explosion

Exodus 1:1-7 narrates that seventy souls descended from Jacob migrated to Egypt and eventually multiplied greatly:

> **1:**1 Now these are the names of the sons of Israel, who came into Egypt with Jacob; every man came with his household: 2 Reuben, Simeon, Levi, and Judah; 3 Issachar, Zebulun, and Benjamin; 4 Dan and Naphtali, Gad and Asher. 5 And all the souls that came out of the loins of Jacob were seventy souls; and Joseph was in Egypt already. 6 And Joseph died, and all his brethren, and all that generation. 7 And the children of Israel were fruitful, and increased abundantly, and multiplied, and waxed exceeding mighty; and the land was filled with them.

Our task here is to investigate this population explosion by estimating both the number of individuals with which it began and the number to which it ultimately gave rise. **Genesis 46:5–27** enumerates the seventy souls who migrated from Canaan to Egypt with Jacob.

> **46:**5 And Jacob rose up from Beersheba; and the sons of Israel carried Jacob their father, and their little ones, and their wives, in the wagons which Pharaoh had sent to carry him.
>
> 6 And they took their cattle, and their goods, which they had gotten in the land of Canaan, and came into Egypt, Jacob, and all his seed with him; 7 his sons, and his sons' sons with him, his daughters, and his sons' daughters, and all his seed brought he with him into Egypt. 8 And these are the names of the children of Israel, who came into Egypt, Jacob and his sons…. 26 All the souls belonging to Jacob that came into Egypt, that came out of his loins, besides Jacob's sons' wives, all the souls were threescore and six. 27 And the sons of Joseph, who were born to him in Egypt, were two souls; all the souls of the house of Jacob, that came into Egypt, were threescore and ten.

The Torah explicitly names, apart from Jacob, 65 males born in Canaan and 2 born in Egypt. Namely: (a) the 12 sons of Jacob: Reuben, Simeon, Joseph, Levi, Judah, Dan, Naphtali, Gad, Asher, Issachar, Zebulun, and Benjamin. (b) Jacob's 51 grandsons: Hanoch, Pallu, Hezron, and Carmi (4 sons of Reuben); Jemuel, Jamin, Ohad, Jachin, Zohar, and Shaul (6 sons of Simeon); Manasseh and Ephraim (2 sons

of Joseph); Gershon, Kohath, and Merari (3 sons of Levi); Shelah, Perez, and Zerah (3 sons of Judah only, Er and Onan having died earlier in Canaan: Genesis 38:7, 10); Hushim (son of Dan); Jahzeel, Guni, Jezer, and Shillem (4 sons of Naphtali); Ziphion, Haggi, Shuni, Ezbon, Eri, Arodi, and Areli (7 sons of Gad); Imnah, Ishvah, Ishvi, and Beriah (4 sons of Asher); Tola, Puvah, Job, and Shimron (4 sons of Issachar); Sered, Elon, and Jahleel (3 sons of Zebulun); and Bela, Becher, Ashbel, Gera, Naaman, Ehi, Rosh, Muppim, Huppim, and Ard (10 sons of Benjamin). And (c) Jacob's 4 great-grandsons, namely Hezron and Hamul (2 sons of Perez, son of Judah) and Heber and Malchiel (2 sons of Beriah, son of Asher). The Torah also names 2 females: one daughter of Jacob, Dinah (v. 15) and one granddaughter of Jacob, Serah daughter of Asher (v. 17)

According to Rashi's commentary on Exodus 1:5, Joseph himself is also counted among the seventy, as implied by Rashi's rhetorical question, "Was he and his sons not included among the seventy?", the verse's statement that Joseph "was in Egypt" serves rather to emphasize his righteousness, that he remained steadfast despite his long residence there. The Torah explicitly includes Joseph's two sons even though they were born in Egypt (v. 27).

Summing up twelve sons, one daughter, fifty-one grandsons, one granddaughter, and four great-grandsons, we get a total of sixty-nine souls. But it is written: "all the souls of the house of Jacob, that came into Egypt, were threescore and ten*"* (v. 27); so, one person is missing. There are two opinions in Jewish tradition as to who the seventieth person might be. One view (based on v. 8) is that it is Jacob; this is advocated by Abraham Ibn Ezra and other commentators (including Adin Steinsaltz). The other view is that it is Jochebed, daughter of Levi and mother of Aaron, Miriam, and Moses; this tradition appears in Talmud Bavli, Baba Batra 123b, and in Genesis Rabbah 94:9, which state that Jochebed was conceived in Canaan but born at the very moment the family entered Egypt, as it were "between the walls."

I would opt for the latter view, because though the Jacob thesis fits in with the number seventy mentioned in v. 27, it does not accord with the number sixty-six in v. 26. Although the same expression "that came into Egypt" (*habaah Mitzraimah*) is used in both verses, it is obvious from the context that v. 26 refers to the group of people *departing for* Egypt, i.e. who left Canaan in the direction of Egypt, while v. 27 refers to the group *arriving in* Egypt, i.e. who somehow ended up in Egypt. This reading is readily confirmed by counting the people involved. The seventy in v. 27 includes, as we have seen, either 68 males and 2 females (if Jacob is included) or 67 males and 3 females (if Jochebed is included instead of Jacob). But the sixty-six in v. 26 must consist of 64 males and 2 females, since it must exclude Joseph

and his two sons. If we subtract these 3 men from the first hypothesis, which includes Jacob (since he set off towards Egypt), we get a count of 67 (65 males and 2 females); whereas if we subtract them from the second hypothesis, and also subtract Jochebed (since she ended up there) from it, we get a count of 66 (64 males and 2 females). Clearly, the latter hypothesis is the correct one.

Genesis 46 appears on the surface to provide us with a credible snapshot of the members of a family at a given point in time; but as soon as one reflects on it a little, one realizes that it cannot possibly be what it seems.

The text does not mention Jacob's wives; we know Rachel died (Genesis 35:19) and we know Leah did (Genesis 49:31); but we have no information regarding Bilhah and Zilpah — they are traditionally presumed dead before Jacob too. Verse 26 makes clear that his son's wives are not included in the list. Verse 6 mentions Jacob's daughters and his son's daughters, in the plural, but only one daughter and only one granddaughter are listed. This is very doubtful if taken literally: one can imagine that Jacob had twelve sons and only one daughter (Dinah) — it can happen, though it is statistically very unlikely. But are we to believe that his twelve sons had, at that late date in their lives, fathered only a single daughter (Serah, daughter of Asher)? Clearly, just as wives are not named or counted, neither are daughters. Dinah is mentioned because she played a dramatic role in the wider narrative (Genesis 34), not necessarily because she was Jacob's only daughter. Likewise, Serah was probably mentioned for some unspecified special reason, not because she was Jacob's only granddaughter. Since, biologically, the ratio of female to male children is on average 1:1, we can and should assume that Jacob and his twelve sons had many unnamed daughters (and that there was, in all likelihood, plenty of marriages between cousins). Similarly, are we to believe that of Jacob's fifty-one grandsons, only two (Perez and Beriah) had at the time fathered sons, i.e. that Jacob only had four great-grandsons at the time? It seems more probable that these four individuals are mentioned in the list for a reason we are not told about, and that there were many more male descendants in that generation than the few who are mentioned.

It is therefore reasonable to suppose that the above listing of "seventy souls" was not originally intended as an exhaustive enumeration — not even of all male descendants of Jacob alive at the time of the migration to Egypt, let alone of all female ones. It was probably a selective genealogical list, shaped by narrative and literary considerations unknown to us, which the author of the present narrative adopted in its existing form for his own purposes — namely, to provide this enumeration of migrants — probably himself inserting in it the total count of seventy (and that of sixty-six) souls mentioned in his Scriptural account.

This statement is not pure speculation, as we shall now prove irrefutably. At the time of the migration to Egypt, Jacob's twelve sons ranged in age from about forty to about twenty. A rough estimate of their ages, based on the narrative of their births (in Genesis 29–30 and 35), places Reuben, Jacob's firstborn, at about forty; Simeon at thirty-nine; Joseph at thirty-nine; Levi at thirty-eight; Judah at thirty-seven; Dan at thirty-five; Naphtali at thirty-four; Gad at thirty-three; Asher at thirty-two; Issachar at thirty-one; Zebulun at thirty; and Benjamin, Jacob's youngest son, at twenty. At these ages, Jacob's sons were all of marriageable age and likely already married; some or all may even have had more than one wife. But what of their named descendants? The Torah does not reveal the ages of these twelve men's fifty-one named sons, nor those of their four named grandsons, so we cannot calculate them precisely. We can, however, make rough estimates using the reasonable assumption that the natural minimum age for male reproduction is about 14–16 years. By adopting this very conservative assumption of the earliest biologically plausible ages for reproduction, we can test the limits of the chronology.

On this basis, consider the descent of Judah narrated in Genesis 38. Suppose Judah was only 14 when he married Bat Shua; he would then have been about 15 when his first son Er was born, and perhaps only one year older at the birth of each of his next two sons, Onan and Shelah (vv. 2–5). Suppose further that Er was 15 when he married Tamar and died soon after; Tamar would then have been given to Onan, now aged about 14, who likewise died shortly thereafter (vv. 6–10). If Shelah reached maturity about one year later (v. 14), Tamar deceived Judah into sleeping with her then; Judah would have been about 32 when she gave birth to their twins Perez and Zerah (vv. 27–30). If Perez in turn married at 14 and his sons Hezron and Hamul were born one year later, Judah would have been 47 at their birth. Yet Judah was in fact only about 37 at the time of the migration to Egypt (he was the fourth son of Leah, born in Haran). A chronological discrepancy therefore arises. Since Judah was about 37 at that time, Perez could have been no more than about 5 years old, and thus far too young to have already fathered Hezron and Hamul. Consequently, these two sons must *still have been unborn* at the time of the migration. The calculation shows that, even under the minimal assumptions regarding reproductive age throughout this investigation, Hezron and Hamul could only have been born at least ten years *after* the family had arrived in Egypt.[57]

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57 *Targum [Pseudo-]Jonathan* on Genesis 46:12 arrived at apparently the same conclusion, though without stating how; the proof here proposed therefore seems to be novel at least in its written form. The author wrote: "And Shelah and Zerah [the other two surviving sons of Judah] did not beget children in the land of Canaan. And the two sons of Perez, Hezron and Hamul, went down

We can likewise consider the line of Asher, who was about 32 at the time of the migration to Egypt; his great-grandchildren would have been at most toddlers 2 years old — *or possibly not yet born* — at the time of the migration. Similarly, Benjamin, aged only about 20 at the time, is recorded as having ten sons. Even allowing for multiple wives or multiple births, it is highly unlikely that all ten were already born by that time, highlighting the same chronological tension, though less extreme than in Judah's line. It follows that some of the named sons of the remaining nine brothers, and all the more their unnamed probable grandsons, might also have been minors or even not yet born. Moreover, since we do not know the ages of all the male descendants of Jacob included in the list, let alone those of the individuals not mentioned in it but probably already born, we can well suppose that many of them were minors at the time of the migration. So, the list cannot even be considered as surely including only mature adults.

These calculations demonstrate indubitably that the list in Genesis 46 is not a literal census of the household at the moment of the migration, but rather a genealogical register of some of Jacob's descendants at some unspecified time — one for sure composed later than the migration. This register was employed by the narrator as if it represented the family that entered Egypt, even though its contents include individuals (Hezron and Hamul) who could definitely not yet have been born at that time. The chronological inconsistency between the list used and the presumed date of the migration therefore appears not to have been noticed by the narrator, and it is indicative of his limited level of information concerning the facts of migration.[58]

All this is of interest to us here, because we need to estimate *just how many adult males entered Egypt at that time and became the progenitors of the subsequent Israelite population involved in the Exodus*. The answer to that question is obviously not seventy. It is *at least* twelve men — meaning the sons of Jacob; and *possibly a few more* men, viz. the grandsons of Jacob who were already sufficiently adult at the time to procreate. Jacob is obviously not to be counted here, since he was already 130 years old at the time (Genesis 47:9), though tradition (Seder Olam Rabbah) claims that he was 77 when he fathered his first son[59]. The twelve sons of

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into Egypt." The latter expression is, I gather, a midrashic device suggesting that they went there "in their father's loins" (i.e. before being conceived, or at least before being born).

58 The author of the Genesis 46 passage in question was, according to R. E. Friedman, the priestly source P. Friedman identifies the author of Genesis 38 as the source J. This difference of authorship would neatly explain why P was apparently unaware of the inconsistency in his own narrative — he was not acquainted with J's narrative.

59 I happen to be 77 at time of writing. Reproduction at that age and beyond, today, would be considered miraculous.

Jacob can be included, *provided* we assume that they were going to have more children than those listed in the said family tree, which is a reasonable assumption in view of their ages. Obviously, if this listing were considered definitive, these men would have no more relevance as potential progenitors, since their contribution to eventual multiplication would already be encapsulated in their named sons.

As regards the latter group, the grandsons of Jacob, it is hard to say without more information how many of them were adult at the time of migration; but we can be sure that the number is well below the fifty-one listed. Reuven, aged 40, had four sons; Simeon, aged 39, had 6 sons; Joseph, aged 39, had 2 sons; Levi, aged 38, had 3 sons; Judah, aged 37, had 3 surviving sons (not counting 2 already deceased); Dan, aged 35, had 1 son; Naphtali, aged 34, had 4 sons; Gad, aged 33, had 7 sons; Asher, aged 32, had 4 sons; Issachar, aged 31, had 4 sons; Zevulun, aged 30, had 3 sons; and Benjamin, aged 20, had 10 sons. I say 'had', but of course I mean 'eventually had' — not 'already had'.

We could say, as a working hypothesis, that a little under half of those sons (say, 24) were already adult, and (since we know for sure of at least one minor, viz. Perez) that a bit more than half (say, 27) were either minor or not yet born. So, let us suppose for the sake of argument that the number of male descendants of Jacob who were old enough to procreate at the time of the descent into Egypt of this family was thirty-six (12 + 24), and let's call them 'the 36 just men' as they fathered the great Jewish people. Clearly, the accuracy of our calculations will depend on the accuracy of this hypothetical initial number. We can now ask the next question: could (or under what conditions could) that many men, with any number of women (one or many wives, of whatever ethnic origin), produce in about 210 years a population with over 600,000 men (and a normally corresponding number of women and children)? That is what we must investigate.

According to traditional Jewish chronology, the migration of Jacob and his family occurred in 2238 AM (1551 BCE), marking the beginning of Israelite life in Egypt (Seder Olam Rabbah, ch. 10). Over the ensuing generations, the Israelites multiplied prodigiously (Exodus 1:7). Most rabbinic sources hold that the total period of Israelite residence in Egypt was 210 years (Rashi on Exodus 12:40; Sanhedrin 91b). Within this period, the Israelites were enslaved for roughly 86 years — the period following the death of Joseph and his generation, when the Israelites lost their initial favor with Pharaoh and were subjected to harsh labor. According to the chronological tradition preserved in Seder Olam Rabbah, this 86-year period corresponds to the span from Miriam's birth until the Exodus, reflecting the years of actual severe oppression. The dramatic liberation known as the Exodus is traditionally dated to 2448 AM (1313 BCE).

When the Israelites departed Egypt after the tenth plague, the Torah reports that "about six hundred thousand men on foot, besides women and children" left Rameses for Succoth (Exodus 12:37). This figure refers broadly to the adult male population; the Levites are not explicitly distinguished here, and the number is clearly an approximation rather than a precise census. The "mixed multitude" that accompanied the Israelites out of Egypt is not included in this figure (Exodus 12:38).

The first formal census occurs in the wilderness, in the second year after the Exodus. Moses was commanded to count all Israelite males from twenty years old and upward, able to go out to war; although the Torah specifies only the lower limit, the upper limit is commonly understood to have been about sixty, corresponding to the standard upper boundary of full adult strength reflected elsewhere in biblical law (e.g. in Leviticus 27:3). The total came to 603,550 (Numbers 1:3, 45–46; 26:2).

The Levites, set apart for sanctuary service rather than military duty, were counted separately slightly later. Of these, 8,580 Levite males aged approximately 25–50 were registered for active service in the Tabernacle (Numbers 4:3; 8:24–25). The Torah mentions both a lower limit of thirty (Numbers 4:3) and of twenty-five (Numbers 8:24); traditional commentators explain that Levites began a five-year period of apprenticeship at age twenty-five and entered full service at thirty, with retirement at fifty. From this figure of 8,580 Levites aged between 25 (or 30) and 50, we can roughly estimate that the total number of Levites aged 20–60 would be about 13,580.

Although the Levite census occurred a short time after the Israelite census, combining the two figures provides a useful perspective on the adult male population aged 20–60 of all twelve tribes at this stage: 603,550 Israelites plus 13,580 Levites, yields a total of approximately **617,130 males**, before including women and children.

We may now formulate our question more precisely and approach it quantitatively. Our working hypothesis is that approximately thirty-six adult men among the descendants of Jacob were of reproductive age at the time of the migration to Egypt. About two hundred and ten years later, the biblical census in the wilderness reports roughly six hundred and seventeen thousand adult males among the Israelites (Levites included). The question, therefore, is whether a population descending from these thirty-six male progenitors — together with all the women accompanying them, including wives (one or several each, of whatever ethnic origin), as well as mothers, sisters, daughters, and other female relatives — could plausibly have grown within that period into a population numbering about 617,000

adult men, along with a corresponding number of elderly men (60+), women and children.

The first step is to measure the scale of the required increase. From a small founder cohort of thirty-six adult men to a final large population of approximately 617,000 adult men represents an expansion by a factor of about seventeen thousand. Such growth must have taken place over roughly 210 years.

At this point, an important feature of population growth should be noted. In a process of exponential expansion, the earliest generations are the most critical. When the population is still very small, even a slight difference in fertility or survival has a large effect on the eventual outcome, because all later growth compounds the numbers already produced. If the first few generations after the migration multiplied slowly, the base population would remain small for too long, leaving insufficient time for the later generations to reach very large numbers. Conversely, if the early generations grew rapidly, the community would soon reach a population of several thousand adults, after which continued growth over many generations could produce very large totals. In other words, the demographic "bottleneck" lies primarily in the first century or so after the migration, when the descendants of Jacob were still few. Once the population had expanded beyond that initial stage, further growth could proceed much more easily.

To illustrate this principle quantitatively, consider how modest growth in the first few generations compounds. Starting with 36 adult men, one illustrative scenario might produce 36 → 100 → 300 → 900 → 2,700 adult males in successive generations. A slightly more favorable reproductive scenario could yield 36 → 144 → 576 → 2,400 → 9,200, and so on. By the fifth or sixth generation, the population would already be in the tens of thousands, providing a base from which the later centuries could plausibly reach the hundreds of thousands reported in the census. These sequences underscore that the earliest generations are the most critical bottleneck: insufficient growth early on would make the final total unattainable, whereas moderate expansion in the first few decades sets the stage for the large-scale population reported at the time of the Exodus.

Additional factors might further increase the potential rate of growth. In the patriarchal period, polygyny was permitted, and men could have more than one wife, as illustrated in the narratives of Jacob, Judah, and Joseph. If the average number of wives per man exceeded one, the number of reproductive women in the population would be correspondingly higher than in a strictly monogamous society. Moreover, intermarriage with surrounding populations appears to have been possible in this early period, as evidenced by Judah marrying the daughter of Shua, a Canaanite (Genesis 38:2), as well as perhaps his union with Tamar (Genesis

38:18), although her ethnic origin is not specified in the Torah and is the subject of various interpretations in later tradition; Joseph marrying Asenath, an Egyptian woman (Genesis 41:45); and Simeon begetting Shaul with a Canaanite woman (Genesis 46:10). Israelite men marrying local women would further increase the pool of reproductive mothers. Favorable hygiene and nutrition may also have reduced child mortality, allowing more children to survive to adulthood and reproduce. Under these exceptional conditions, the average number of births required per woman could be considerably lowered.

Two contrasting demographic scenarios may therefore be envisaged. Under ordinary historical assumptions — longer generational intervals of 25–30 years, predominantly monogamous households, and the usual levels of child mortality — the increase from 36 adult men to over 600,000 adult men within 210 years would require exceptionally large families sustained over many generations and would appear extremely difficult to achieve. Under more exceptional assumptions — shorter generations of 20 years, multiple wives occasionally, intermarriage with surrounding populations, favorable child survival, and extremely high fertility — the growth becomes demographically conceivable.

Very rapid generational turnover and greater reproductive capacity seem plausible in the cultural and social environment suggested by the biblical narratives. Marriage occurred relatively early in life, and procreation was strongly encouraged, with many men taking more than one wife. The interval between successive generations could therefore be around twenty years (compared to the usual 25 years in ordinary historical demography). Over a span of about 210 years, this would allow roughly ten to eleven generations (compared to seven or eight under ordinary assumptions). With this generational turnover, the male population would need to increase by a factor of about 2.65 per generation (compared to roughly 3.5 to 4 in the ordinary scenario), and the female population would grow similarly. This implies that each man would leave on average about 2.65 surviving sons and an equal number of surviving daughters. Given premodern child mortality (with roughly 60% of births surviving to adulthood), this would require around nine births per woman over her lifetime (compared to 10–12 under ordinary assumptions). In households where men had more than one wife, the required fertility per woman would be somewhat lower. While such fertility is high, the shorter generation interval and early marriage make the required reproduction considerably less extreme than under ordinary demographic conditions.

Using the census figure of roughly 617,000 adult men aged 20–60, we can also estimate the total population including women, children, and seniors. Adult women of comparable age would number roughly 617,000. Children under 20 — excluded

from the census — may comprise 40–50 percent of the population, while adults above 60 represent roughly 5–10 percent. On this basis, the 617,000 adult men correspond to about 617,000 adult women, 500,000–600,000 children under 20[60], and 60,000–120,000 seniors. The total population thus falls in the range of approximately 1.79–1.95 million individuals. So, the traditionally advanced figure of **about two million** is reasonable and is the one we shall adopt in our further investigations. Some traditional sources further speak of an additional one million individuals belonging to the "mixed multitude" (*erev rav*) that accompanied the Israelites out of Egypt; however, this figure has no basis in the Torah itself and appears to derive from later, non-classical writings — it is retained here solely for illustrative purposes, without implying endorsement[61]. Overall, across all age groups, about half the population is male and half female, consistent with natural sex ratios in a healthy early-agricultural society.

In conclusion, the biblical population figures imply extraordinarily fast expansion. Under ordinary demographic conditions, such growth would be highly improbable. Yet if the exceptional conditions outlined above are granted — conditions that include early marriage, high fertility, multiple wives, intermarriage, and sustained population growth — the numbers are not mathematically impossible. The exponential growth in the earliest generations represents the main bottleneck, and the extraordinarily rapid reproduction during the last 86 years of slavery is explicitly suggested by the biblical text (Exodus 1:7; Seder Olam Rabbah 7; Genesis Rabbah 94:9). Taken together, these factors render the reported Exodus numbers plausible within a natural, though highly accelerated, demographic framework.

Regarding the credibility of the traditionally assumed total Israelite population, it is instructive to compare it with scholarly estimates for the population of ancient Egypt at the time, i.e. around 1300 BCE according to traditional reckoning (corresponding to the New Kingdom of Egypt). These estimates are necessarily

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60 The figure of roughly 500,000–600,000 children under 20 is based on standard demographic proportions in premodern populations. Assuming a reproductive rate of about 5.3 surviving children per adult man, this estimate appears compatible with the total population of roughly two million, given that not all children would be under age 20 at any one moment and that the adult population spans ages 20–60. The estimate does not attempt to specify exact birth spacing or mortality patterns, but provides a plausible range consistent with typical early-agricultural population structures.

61 Traditional and kabbalistic sources (e.g., Zohar II, 191a) describe the "mixed multitude" that accompanied the Israelites as very numerous, but do not provide a figure of one million; this number appears to originate in later, non-classical writings.

approximate and rest on indirect methods rather than formal census data. Scholars typically reconstruct population size by combining calculations of the Nile Valley's agricultural carrying capacity with archaeological evidence from settlements, supplemented by administrative records and comparative pre-modern demography. While each line of evidence involves significant assumptions — particularly regarding crop yields, land use, and household size — the different approaches tend to converge on a broadly consistent range. Accordingly, most estimates place Egypt's total population at roughly 2 to 4 million people, with about 3 million often taken as a reasonable midpoint.

If one compares the biblically reported Israelite population of some two million souls with this modern estimate for Egypt as a whole, the Israelites would have constituted an exceptionally large share — on the order of one-half, and potentially even a majority (approaching two-thirds or more) — of the population of Egypt. Such a scenario would be highly unusual. In most known slave societies, enslaved populations form a minority or, at most, a substantial plurality: estimates for classical Athens and Roman Italy typically fall in the range of 20–40%, while in the antebellum Southern United States the proportion was broadly similar, exceeding 50% only in certain localities rather than across the entire society. The biblical figure, if taken at face value, would therefore imply a demographic situation that is markedly atypical by historical standards.

2. The splitting of the sea

In this section, we shall look into various issues relating to the Israelites' exodus from Egypt and their journey through the Sinai desert to the land of Canaan, which was to become their heritage. This is not intended to be an exhaustive study. We shall not, for examples, discuss the Ten Plagues that made their escape from slavery possible or the subsequent Revelation at Mount Sinai, even though both are narratives crucial to Judaism. Rather, we shall focus on more prosaic matters, insofar as they can be quantified and critically examined.

The first calculation to be made concerns the area occupied by the fugitive Israelites while on the march. In order to estimate this, one must begin with a reasonable assumption regarding density. A tightly packed crowd may reach several persons per square meter, but such conditions are wholly unrealistic for a migrating population that included families, children, the elderly, and large numbers of animals. A more plausible figure is on the order of 4 m^2 per person, allowing for movement, baggage, and livestock. On this basis, a population of approximately two million individuals would occupy roughly 8 km^2, and quite possibly more if

one takes fuller account of livestock. Interestingly, this estimate corresponds quite closely to the traditional notion of *arba amot* — a square measuring four cubits by four cubits — found in rabbinic literature, which yields an area of roughly 3–4 m² per person.

Once the total area is estimated, it may be translated into the dimensions of a marching column. If we posit an intermediate formation between a narrow caravan and a broad advance — say, a width of 2–3 km — the column would extend to a length of approximately 3–5 km. Conversely, assuming a somewhat broader front of 3–5 km, the depth of the column would be reduced to roughly 2–3 km. In either case, what emerges is not an excessively elongated line but rather a compact, though still substantial, moving mass.

As for the rate of progress, this would necessarily have been governed by the slowest elements of the population. While an unencumbered adult may walk at 4–5 km per hour, large pre-modern groups composed of mixed ages and accompanied by animals typically advance at a considerably slower pace. A reasonable estimate in this case would be on the order of 2 km per hour. Allowing for some five to seven hours of movement per day, this yields a daily advance of approximately 10–15 km. It should be noted, finally, that even a column of only a few kilometers in length would not move as a single, simultaneous unit. At a pace of 2 km per hour, a column 3–5 km long would require up to two hours for its rear to reach the point at which the front had begun to move. The process of breaking camp and setting out would therefore have been staggered, with the result that the mass of people advanced in a kind of rolling progression rather than as a single coordinated block.

All these figures, however, pertain to the Israelites alone. If one includes the *ʿerev rav* (the "mixed multitude" mentioned in Exodus 12:38), traditionally estimated at an additional one million people, together with their livestock, the total moving population increases by roughly fifty percent. The spatial, temporal and logistical parameters outlined above would therefore need to be scaled accordingly: the total area would rise to approximately 12 km² or more, and the corresponding dimensions of the marching column would expand proportionately.

The Torah does not present a clear or continuous picture of the Israelites' route during their peregrinations from Egypt to the Promised Land. Rather, it records, in scattered passages, a sequence of key stations along the journey. The departure begins from Goshen (Exodus 12:37–38), followed by encampments at Succoth and Etham (Exodus 13:20), then a turn toward the sea near Pi-hahiroth, Migdol, and Baal-zephon, culminating in the crossing of the Yam Suph (Exodus 14:2, 14:21–22). After the crossing, the journey proceeds through Marah, Elim, and the Wilderness of Sin (Exodus 15:23–27; 16:1), then on to Rephidim and Mount Sinai

(Exodus 17:1; 19:1–2). Subsequent stages include Kibroth-hattaavah and Hazeroth (Numbers 11:34–35; 12:16), and Kadesh-barnea (Numbers 13:26; Deuteronomy 1:19), before reaching the Plains of Moab opposite the Jordan River, from which entry into the land begins with Jericho (Numbers 22:1; Deuteronomy 34:1–5; Joshua 3–6). To this day, the precise geographical locations of many of these place-names remain uncertain, and both traditional and modern scholars have proposed a wide range of identifications and interpretations.

To illustrate the distances involved in a journey from Egypt to the Promised Land, let us arbitrarily take (say) modern Ismailiyah as the point of departure and (say) modern Beersheba as the destination. The straight-line distance between them is approximately 250 km. At a steady pace of 2 km per hour, and assuming 6 hours of walking per day, a column of Israelites would require roughly 21 days of walking to cover this distance. Accounting for the Sabbath, on which no walking would occur, this increases to about 25 total days. By contrast, if the group followed the perimeter of the Sinai Peninsula — marching south along the Gulf of Suez to the tip of the peninsula, then turning northwards along the Gulf of Eilat, the other arm of the Red Sea, toward Eilat and finally on north to Beersheba — the distance would be about 800 km. At the same pace, this roundabout route would require 67 walking days, or 78 days including Sabbaths. So, whatever the route the Israelites took, they could in principle have completed the trip in one to three months.

Exodus 13:17–18 explains why the Israelites were taken on a longer route, rather than taken straight to their destination, as follows: "And it came to pass, when Pharaoh had let the people go, that God led them not by the way of the land of the Philistines, although that was near; for God said: 'Lest peradventure the people repent when they see war, and they return to Egypt.' But God led the people about, by the way of the wilderness" by the Sea of Reeds (*Yam Suph*). In other words, the roundabout, southern route was preferred because the direct, northern route along the coastal plain posed some danger from the inhabitants there[62].

The Israelites' first stage of departure from Egypt began at Succoth, generally situated by scholars in the eastern Nile Delta. From there, the biblical narrative

62 It should be noted that, from a secular historical and archaeological perspective, there is little evidence that the Philistines were present in southern Canaan at the time traditionally associated with the Exodus (around 1300 BCE according to Jewish chronology). Archaeological data indicate that distinct Philistine settlements, material culture, and coastal dominance appear only in the 12th century BCE, c. 1175 BCE, more than a century after the proposed Exodus date (and, incidentally, several centuries after the accounts of Abraham and Isaac interacting with Philistines). If this is correct, the biblical reference to "the land of the Philistines" would reflect a later historical reality anachronistically inserted into the Exodus narrative.

describes their movement toward *Yam Suph*, traditionally rendered as the "Sea of Reeds." Modern scholarship is divided regarding the precise location of this body of water. The Hebrew term *yam* is a general designation for a "sea" or large body of water and is not restricted to deep, open oceans; in biblical usage it can also denote lakes, inland seas, or broad marshy or lagoon-like expanses. Accordingly, the expression *Yam Suph* is often interpreted, by some scholars, as referring to a reedy lagoon or wetland system in the northeastern Nile Delta–Isthmus of Suez region rather than a deep marine basin.

Among the northern proposals, Lake Timsah is frequently regarded as the most plausible candidate on geographical and physical grounds, given its location along the natural corridor linking the Nile Delta to Sinai and its relatively greater present-day depth, on the order of roughly 10–16 meters. It is nevertheless important to note that this depth reflects modern conditions; in antiquity, Lake Timsah was likely part of a broader and more dynamic lagoon–marsh system, with shallower and more variable depths than today. Within that reconstructed environment, it may have presented a more substantial body of water than the surrounding wetlands, making it a comparatively stronger candidate within the "Sea of Reeds" framework. By contrast, Lake Bardawil — also known historically as Lake Sirbonis — is typically considered too shallow to fit interpretations that envisage a significant water column, with average depths of approximately 2–3 meters. It lies along the northern Sinai coast close to the Mediterranean Sea, separated from it by a narrow sandbar, and is generally characterized as a shallow coastal lagoon rather than a substantial inland basin. Likewise, Lake Manzala, with depths typically on the order of 1–2 meters and characterized by extensive marshy conditions, is more consistent with a reed-filled wetland than with a substantial body of water capable of sustaining a crossing marked by pronounced 'walls' of water. The Great Bitter Lake and Little Bitter Lake are sometimes mentioned in related discussions, but their present form is largely the result of modern Suez Canal engineering. In antiquity, they are thought to have existed primarily as saline depressions or intermittently flooded basins rather than as the large, clearly defined lakes observed today, and thus their historical configuration is uncertain.

These various northern candidate sites, located directly east of the Nile Delta, are broadly consistent with the Exodus itinerary from Goshen toward Sinai and align plausibly with the linguistic evidence, since the Hebrew word *suph* literally means "reed," and, as noted, the term *yam* can denote a range of bodies of water or wet environments. However, they are generally considered too shallow to account for the dramatic 'splitting of the sea' described in Exodus, in which the waters are

divided to allow the Israelites to cross on dry ground before subsequently closing upon the pursuing Egyptians.

By contrast, the Gulf of Suez, the northwestern arm of the Red Sea south of the modern city of Suez, offers a more compelling candidate, primarily because of its greater scale and depth, though not for that reason alone. While *suph* ("reed") may at first suggest marshy shallows, the term *Yam Suph* is used more broadly in the Torah — not only for the site of the crossing in Exodus but also for waters associated with the Gulf of Eilat (Deuteronomy 1:1; Numbers 21:4) — indicating that it can denote the Red Sea proper and is therefore not geographically restricted to a single type of environment. On this basis, a Gulf of Suez location remains linguistically viable alongside the northern lagoon hypotheses. Moreover, reed beds (e.g. *Phragmites australis* and related marsh plants) develop wherever shallow, relatively calm water exists along the margins of larger bodies, including gulfs, estuaries, and coastal inlets. There is thus no ecological obstacle to their having fringed portions of the Gulf of Suez in antiquity, particularly in areas influenced by wadi outflows, seasonal runoff, or localized groundwater seepage.

For the purposes of this study, the Gulf of Suez hypothesis will therefore be adopted. It provides a setting that is both physically plausible for a dramatic fugitive crossing and geographically consistent with the Israelites' route from Goshen into the Sinai, while also doing justice to the grandeur implied by the Torah narrative. In particular, it offers a body of water of sufficient width and depth to accord with the biblical depiction of the sea being miraculously parted for the fleeing Israelites, and of the pursuing Egyptians being subsequently overwhelmed and drowned. Its depth along its central axis ranges from about 20 meters in the north to about 70 in the south.

Given this assumption, the Israelites may be envisaged as moving south-southeast from Succoth in Goshen toward the Gulf of Suez, camping at a place called "Etham, in the edge of the wilderness" (Exodus 13:20)[63]. The straight-line distance to the northern reaches of the gulf is approximately 100–120 km, depending on the precise point of crossing. Allowing for the slow pace of a large and heterogeneous population — including families, children, the elderly, and livestock — at roughly 2 km per hour for 5–7 hours of travel per day, this stage of the journey would likely have taken on the order of 7–12 days, depending on conditions. Unlike the marshy terrain of the Nile Delta, the route toward the gulf traverses more open desert, necessitating careful management of water supplies, grazing, and encampment

63 Some traditional commentators, including Ramban, similarly situate Etham along the route to the Red Sea. The different locations proposed by secular scholars remain equally speculative.

logistics. This estimate offers a plausible framework for understanding the initial phase of the Exodus prior to reaching the site traditionally associated with the dramatic crossing described in the biblical narrative.

Two verses in Exodus 14 provide relative, though not absolute, information about the location of the sea-crossing narrative. Verse 2 instructs: "Speak unto the children of Israel, that they turn back and encamp before Pi-Haḥirot, between Migdol and the sea, before Baal-Zephon, over against it shall ye encamp by the sea." Verse 9 states: "And the Egyptians pursued after them… and overtook them encamping by the sea, beside Pi-Haḥirot, in front of Baal-Zephon." My reading (granting the Red Sea hypothesis) places the Israelites on the west coast of the Red Sea, with Pi-Haḥirot to their west and Migdol further west, while Baal-Zephon is located either to the east of the Israelites on the opposite shore in Sinai, or alternatively somewhat to the north or south along the western shore.[64]

The place names themselves offer contextual clues: Migdol likely refers to a fortified installation or tower, a term attested in Egyptian frontier contexts; Pi-Haḥirot is considered by many to be of Egyptian origin and is commonly understood to mean an opening, canal mouth, or marshy outlet; and Baal-Zephon is widely understood as a cultic or landmark site associated with a Semitic deity. Taken together, the descriptions point to a setting on Egypt's eastern frontier, near a body of water and in proximity to defensive structures and recognizable landmarks. The command that the Israelites "turn back" (presumably from Etham, their preceding station) suggests they had already advanced beyond the location where they were to encamp and cross, reinforcing the impression of a repositioning toward a specific coastal or near-coastal area identified by these named features.

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64 Note in passing that the phrases *lifnei pi ha-ḥirot* (Exodus 14:2) and *al-pi ha-ḥirot* (Exodus 14:9) both refer to the same underlying toponym, *ha-ḥirot*, with the prefixed definite article *ha-* ("the") indicating that *ḥirot* is a place name, likely originally descriptive of a geographical feature such as an opening, passage, or recess. Contrary to the common reading that treats "Pi-Haḥirot" as a single place name, the syntax suggests that *pi* ("mouth" or "entrance") is a construct term modifying *ha-ḥirot*, rather than an inseparable part of the proper name itself. In both expressions, *pi ha-ḥirot* therefore means "the mouth/entrance of Haḥirot," while the prepositions *lifnei* ("in front of" or "facing") and *al* ("at" or "by") specify the relative position of the respective parties with respect to that feature: in Exodus 14:2, *lifnei pi ha-ḥirot* describes the Israelite encampment as facing or opposite the entrance of Haḥirot, whereas in Exodus 14:9, *al-pi ha-ḥirot* indicates the location at which the Egyptian forces caught up with them, i.e. at or in the vicinity of that same entrance. In both cases, the text uses *Haḥirot* as a fixed geographic reference point, with "mouth/entrance" marking a specific access point within that locale and the differing prepositions refining the spatial relationship of the Israelites and their pursuers to it.

For the purposes of this study, a plausible crossing site for the Israelites can be identified along the western arm of the Red Sea, namely the Gulf of Suez, running from the vicinity of Adabiya on its western shore to the area traditionally known as the "Springs of Moses" (Ayin Musa)[65] on the opposite, Sinai shore. This line lies roughly 50–60 km south of the modern city of Suez and spans about 20-22 km from shore to shore. Along this stretch, the seabed features gentle shallows near both coasts and a deeper central basin averaging approximately 30-40 m in depth, providing a combination of moderate width, manageable gradients, and substantial depth. These dimensions make the gulf far larger and deeper than the delta lakes and marshes, while still allowing near-shore shallows that could plausibly have supported reeds or marshy vegetation in antiquity.

Granting this hypothesis, it remains necessary to explain why the Israelites did not simply cross into Sinai overland, say just north of the Gulf of Suez, in the vicinity of the modern city of Suez. One possible explanation is that they were deliberately led to a coastal position so that the miracle of the sea's division might occur there, with the returning waters serving as the means by which the Egyptian pursuit would be brought to an end. According to Exodus 14:21, a "strong east wind" blew overnight, driving back the waters of Yam Suph and drying the seabed so that the Israelites could pass: "And Moses stretched out his hand over the sea; and Hashem caused the sea to go back by a strong east wind all the night, and made the sea dry land, and the waters were divided."[66]

Envisioning the crossing, one may imagine a dried seabed corridor along this section of the gulf, roughly 5 km wide and 21 km long, flanked on both sides by the displaced waters forming the "walls of water" described in Exodus 14:22. The Israelites could have advanced through this corridor in a formation approximately 2–3 km wide and 3–5 km long, accommodating a population of roughly 2 million people, including families, children, the elderly, and livestock. Importantly, the corridor would have lain, on average, some 35 m below the level of the surrounding shores, meaning that the people first needed to carefully descend into the seabed and then climb up again on the far side. This was no simple matter: children, the

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65 This oasis, situated only a few kilometers inland from the coast, is traditionally identified with the episode described in Exodus 15:22–27, in which Moses renders the bitter waters sweet. Its identification with Marah, however, remains uncertain, since verse 22 appears to place that site a three-day journey into the wilderness from the point at which the Israelites emerged after crossing the sea.

66 Be sure to watch the classic 1956 cinematic portrayal of the parting of the sea in *The Ten Commandments*, directed by Cecil B. DeMille, starring Charlton Heston as Moses; the scene is available here: https://www.youtube.com/watch?v=j3CANELyPo0.

elderly, and animals would have required additional care and slower movement, and the slopes in and out were likely irregular rather than smooth, adding significant physical exertion and time.

Moving at a moderate pace of about 2 km per hour over the firm seabed, and allowing for the extra time needed to negotiate the entry and exit slopes, the crossing would likely have taken closer to 12–13 hours for each participant. For the column as a whole, including the delay caused by the column's length at the entry side (roughly 3–5 km), the total elapsed time from the first person entering the seabed to the last person exiting would be approximately 14–15 hours. Including the "mixed multitude," traditionally estimated at roughly one million additional people, would further increase the spatial footprint, logistical complexity, and the total elapsed time for the column as a whole.[67]

Regarding the time taken for the crossing, for any individual — and all the more for such a mass of people and animals — to complete so arduous a journey within a single day is highly questionable. Assuming a two-day duration seems more reasonable (within our Gulf of Suez hypothesis concerning the location of the events). Indeed, Exodus 14:19-30 seems to confirm this scenario, since the east wind blew "all the night" (v. 21), after which the Israelites "went into the midst of the sea upon the dry ground" (v. 22), and the pursuing Egyptians "went in after them" (v. 23), then "it came to pass in the morning watch" that Hashem "discomfited" the Egyptians (v. 24), taking off their chariot wheels and making them to drive heavily (v. 25), after which Hashem told Moses "Stretch out thy hand" (v. 26) and consequently "the sea returned to its strength when the morning appeared" (v. 27).[68]

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67 The Talmud (Pesachim 118a, Sotah 36b) and some midrashim, such as the Mechilta de-Rabbi Ishmael, describe the sea splitting into twelve paths, one for each tribe. However, that scenario is highly questionable: it is not hinted at in the biblical text itself and introduces additional narrative difficulties. It would require an even more complicated miracle for the east wind to create and maintain all twelve paths simultaneously. Moreover, it would not accelerate the crossing: individuals could not proceed any faster no matter how many routes were made available; and as for the group as a whole, the logistics needed to separate the tribes would surely slow them down. Furthermore, the pursuing Egyptians would likely face confusion in deciding which of the many offered routes to follow! Some commentators, including Rashi and Ramban, interpret the tradition of twelve paths as symbolic rather than literal, emphasizing the miraculous nature of the event without requiring twelve distinct corridors.

68 Incidentally, the rabbinic tradition that Nachshon ben Aminadav entered the sea first, advancing "until the waters reached his neck" (BT Sotah 37a), is not easily reconciled with the plain sense of the biblical narrative, according to which the Israelites crossed in the morning only after the seabed had been prepared overnight. Maybe, since the sea was split from east to west, the

If the wind blew all night, the Israelites could not set off before morning; then they had a crossing of 14-15 hours during which the sea walls could not collapse, so that the soonest they could all arrive on the opposite shore was *only late that evening*. The pursuing Egyptians might have followed them into the sea soon after the last fugitives stepped into it; but being on horse-drawn chariots that could not have been earlier than a few hours after the first fugitives had stepped in, in the late morning at the earliest, or they would have caught up with the fleeing column too soon. It follows that since, on the contrary, the Egyptians were in fact discomfited in the *morning* watch (i.e. shortly before daybreak) and the sea walls collapsed when the *morning* appeared, that morning could only have been *the second* morning. So, clearly, the Israelites were in fact given 24 hours or more to traverse the sea, and could very well have rested on the seabed for hours at a time (at most nine or ten) on the way. While traditional commentators do not posit two-day scenario, they do not explicitly deny the possibility either.

Note that, since the Egyptians say, "Let us flee from before Israel" (v. 25), and when the sea returns "the Egyptians fled toward it" (v. 27), it follows that, while the walls of water were raised under the force of an east wind, their collapse occurred in the opposite direction, from west to east, thereby cutting off the Egyptians' line of retreat and preventing their escape. A modern image would be to say that the sea zipped open from east to west and zipped shut again from west to east. Note in passing that the Torah does not specify whether Pharaoh entered the sea with his troops, nor whether (if he did enter) he died there or survived.[69]

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corridor formed was not quite fully dry on the western shore when Nachshon entered it. A possible harmonization notes the distinction in Exodus 14:21–22, between *ḥaravah* (v. 21), "made the sea dry land," suggesting a process of drying, and *yabbashah* (v. 22), "upon the dry ground," indicating fully dry land suitable for passage. Thus, the Torah may describe a transition from drying to dry, which could align with the Talmudic portrayal of Nachshon walking into water. While the tradition offers a powerful 'just do it' lesson of faith, it is best understood as homiletical rather than a literal detail of the historical sequence.

69 Later Jewish sources are divided on this issue: some assume (Abraham ibn Ezra; Ovadia Sforno) that he perished with his army, while others (Pirkei de-Rabbi Eliezer 43; Yalkut Shimoni on Jonah) explicitly maintain that he entered the sea corridor but did not drown like his troops — possibly in order to illustrate a psychological movement from defiance to repentance and final submission to God. The latter commentaries even claim that he went on to become the king of Nineveh mentioned in the book of Jonah, presumably in order to explain the ease with which that king repented. To my mind, all this is speculative. The most likely answer, given the absence of any historical record of a pharaoh of that period drowning with his army, is that Pharaoh survived and returned to his palace, living and dying as pharaohs were wont to do.

From a physical perspective, the forces involved are staggering. Consider a hypothetical parting of the sea along a corridor approximately 5 kilometers wide and 21 kilometers long, where a slice of water about 35 meters deep — roughly the height of a twelve-storey building — is displaced to form two vertical "walls of water" on either side of the passage, as described in Exodus 14:22. The scenario can be understood in three phases over a total of 40 hours: an initial 10-hour phase (from about 7 pm to 5 am) in which the sea is progressively parted (at roughly 10 percent per hour from east to west), a 24-hour phase (from about 5 am to 5 am) during which the fully opened corridor is maintained for the Israelites' crossing and rest, and a final 6-hour phase (from about 5 am to, say, 11 am) in which the walls return gradually (at roughly one-sixth per hour from west to east) until the sea closes again. Our analysis seeks to estimate the force and energy required to part the water, maintain the walls once formed, and allow their controlled return, taking into account that previously displaced water must continue to be supported as additional sections are opened. It also considers whether — and at what additional cost — the seabed along the entire corridor could be kept dry and stable throughout the crossing period, given the effects of pressure imbalance, seepage, and soil strength.

It is important to realize that the east wind mentioned in the text would have to operate in a highly unusual, multidirectional manner to achieve its purpose. Blowing from the eastern side of the gulf in the direction of the Israelites on the opposite shore, it would first need to pound down on the sea, exerting the immense force needed to displace it on both sides and form the flanking walls in a single night. Simultaneously, it would need to maintain those walls, once formed, holding up the waters to its left (south) and right (north). Such a powerful wind would obviously devastate any population standing in its path, causing widespread injury and death. To avoid striking the Israelites stationed by the sea, the wind would have to rise sharply and harmlessly just as it reached the western shore. When, in the morning, the Israelites crossed the sea along the dry corridor created by the wind overnight, it would have to continue blowing in an extremely localized and precise manner — strong enough to hold the waters back on either side of the passageway, yet gentle or effectively absent in the central part of the corridor. Only in this way could it, while the enormous flanking walls of water remained suspended along the edges, allow families, children, the elderly, and livestock to traverse the seabed safely and without difficulty. This finely tuned, selective phenomenon necessarily surpasses ordinary natural forces. While it would obviously have been a simpler miracle to command the sea itself to split, Scripture specifically emphasizes that a "strong east wind" accomplished the task.

The creation of the corridor requires the displacement of roughly 3.7 billion cubic meters of water, corresponding to a mass of some 3.8 trillion kilograms. The work required to lift and redistribute this mass against gravity amounts to approximately 6×10^{14} joules[70]. Spread over a 10-hour opening phase, this implies an average power output on the order of 17–18 gigawatts, comparable to the peak capacity of a major national power grid. Once established, the two walls of water — each approximately 35 meters high — exert a combined continuous lateral force of roughly 252 billion newtons. Maintaining a static configuration would theoretically require force rather than continuous energy input, though in practice a degree of active stabilization would likely be necessary to suppress turbulence and leakage over the 24-hour crossing period, implying a sustained power requirement on the order of hundreds of megawatts, depending on conditions. During the final phase, the return of the sea would release the stored gravitational potential energy in a massive surge, with the restraining forces diminishing as the walls collapse inward.

While the walls of water are the most visually striking aspect of the scenario, a significant additional physical challenge lies in the behavior of the seabed itself. Beneath the surface of the corridor, the sudden removal of a roughly 35-meter column of seawater reduces the hydrostatic (gauge) pressure by approximately 3.46 atmospheres (≈351,000 pascals[71]) — a value derived from seawater density (~1025 kg/m³) and corresponding to the weight of the water column alone, excluding atmospheric pressure. In simple terms, the ground beneath the seabed is saturated with water that is normally under pressure from the surrounding sea; when the overlying water is removed, the pressure in the corridor is lower than that in the adjacent seabed. This pressure difference drives pore water to migrate toward the lower-pressure region, tending to rise upward into the corridor. As the system re-equilibrates, hydraulic gradients develop within the sediments, inducing pore water flow that can weaken soil structure and lead to localized seepage, softening, or sand boils. The reduction in confining pressure further contributes to instability in saturated sediments, and conditions may develop that result in an uneven and potentially hazardous corridor underfoot. Maintaining a stable, traversable passage would therefore require not only lateral restraint of the water masses forming the walls but also stabilization of the seabed itself — functionally a form of vertical

70 A joule (J), the SI (International System of Units) unit of energy, is the amount of energy transferred when a newton moves an object one meter in its direction; a newton (N), the SI unit of force, is defined as the force required to accelerate a one-kilogram mass by one meter per second squared.

71 A pascal (Pa) is the SI unit of pressure, defined as the pressure exerted when a force of one newton is applied uniformly over an area of one square meter.

anchoring to preserve ground integrity and prevent these subsurface processes from undermining the corridor throughout the crossing period.

The Torah narrative — "And He took off their chariot wheels, and made them to drive heavily" (Exodus 14:25) — may be read as reflecting precisely such variations in pressure on the seabed. Where and when the supporting (or stabilizing) pressure on the sea floor is reduced, the sediments would tend to become saturated and unstable, producing mud or quicksand-like conditions with exactly the effect described on chariot wheels and their mobility.

The total energy involved in the sea-splitting event — dominated by the initial displacement but allowing for realistic inefficiencies — reaches on the order of 10^{15} joules, equivalent to roughly 250 kilotons of TNT, or approximately 15–20 times the energy released in the atomic bombing of Hiroshima in 1945 (commonly estimated at approximately 15 kilotons of TNT). These figures illustrate the immense scale and complexity of the phenomenon, showing that, if taken literally, it would involve forces and sustained power far beyond any wind or hydrodynamic process known on Earth.[72]

The magnitude becomes even clearer when compared with natural extremes: the strongest sustained winds on Earth, such as those in Category 5 hurricanes, reach speeds of about 100 m/s. Even acting continuously over the entire corridor, such winds would generate only about 3.6% of the force required to hold back a 35 m-high wall of water over 21 km — implying that a wind roughly 28 times stronger than a Category 5 hurricane would be needed to achieve the same effect (corresponding to wind speeds on the order of 500–550 m/s). Other extreme winds, including tornadoes or Antarctic katabatic flows, fall further short, both in magnitude and in their inability to maintain a long-duration, spatially controlled effect. If the biblical description is taken literally, the "strong east wind" would need to operate far beyond any known natural force, both in magnitude and in its selective ability to restrain the waters on either side while leaving the central passage traversable. This reinforces the earlier estimate that the event would require not only an enormous total energy input, but also a sustained and highly directed power output exceeding any known atmospheric mechanism.[73]

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72 A phenomenon sometimes invoked in this context to explain the splitting of the sea is the so-called "wind setdown effect," that is, a wind-driven lowering of water level due to the horizontal displacement of the water mass. Such processes, however, produce only a gradual recession of water rather than a sharply defined passage bounded by vertical walls, and are insufficient to account for the scale and character of the event described here.

73 Incidentally, a natural tsunami, due to an earthquake, could not account for the biblical scenario of the Yam Suph crossing. Tsunamis are brief, transient waves that draw water away for

Taken together, the analysis highlights that what may appear in narrative form as a single dramatic event in fact entails a tightly interdependent set of physical challenges involving large-scale energy transfer, sustained force, pressure dynamics, and ground stability. Even allowing for idealizations, the combination of these requirements underscores the extraordinary nature of the phenomenon as described. In other words, if this event historically occurred, it could not have been, as some have suggested, a timely freak natural occurrence; it would have required a level of control and coordination consistent only with a miraculous intervention. One firm conclusion emerges from our analysis: we have not shown that the sea-splitting event was impossible, but we have demonstrated that it could not have occurred through natural processes.

As regards its historicity, to date there is no concrete evidence that it ever occurred. Of course, a split sea event would not be reasonably expected to leave a lasting physical trace. However, since Exodus 14:7 states: "And he took six hundred chosen chariots, and all the chariots of Egypt, and captains over all of them," and verse 28 adds: "And the waters returned, and covered the chariots, and the horsemen, even all the host of Pharaoh that went in after them into the sea; there remained not so much as one of them," one could reasonably hope to find some physical vestiges of the Egyptian army dating from that period on or in the sea floor. Any such findings would provide a degree of corroboration of the event (though not absolute proof). Maybe in the future underwater drones equipped with sensitive detection and imaging equipment will be capable of exploring the relevant regions of the seabed and uncovering such archaeological evidence.

As for the physical vestiges that one might hope to find, durable elements — particularly bronze components such as weapon heads (arrowheads, spear tips, blades), metal fittings from chariots, and occasional fittings from shields or armor — would be the most likely to survive and be recoverable in underwater archaeological contexts. By contrast, the majority of Egyptian war equipment of the New Kingdom period was made from perishable materials: chariots were primarily constructed of wood reinforced with leather and wickerwork; composite bows combined wood, horn, and sinew; and shields and protective gear relied largely on wood, leather, and other organic materials. These organic components

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only minutes to a few hours, and they do not create static, dry corridors. Maintaining a 21 km-long, 5 km-wide passage with walls of water on either side for at least 12–13 hours (or longer for a large column of people and animals) exceeds the capabilities of any known natural phenomenon. Moreover, the violent return of water typical of tsunamis would have swept away anyone on the seabed and along the shores, making a safe crossing physically impossible.

rarely survive underwater except under exceptional preservation conditions and would therefore be unlikely to be found.

How then should we conclude this section on the splitting of the sea? A reader of the Torah focused exclusively on scientific method would argue that, since the proposed phenomenon could not possibly have occurred by natural means and since there is no empirical evidence that it ever happened, we are logically bound to regard it as legendary, whether or not the narrator so intended it. Such a reader might nonetheless salvage the narrative somewhat by emphasizing the value of its moral and theological message of Divine deliverance of the oppressed and punishment of their oppressors. Another kind of reader, committed to a literal interpretation of the Torah and open to the possibility of miracles, would argue instead that the exceptional complexity and scale of the phenomenon are consistent with its characterization as a miracle and do not, in themselves, undermine its credibility. Such a view would also emphasize that the current absence of physical evidence does not preclude the possibility that evidence may yet be discovered. In the end, it is up to each reader to decide which perspective he or she finds more compelling.

3. Water provision in the desert

Let us now look closely into the needs for water of the Israelites during their forty years of wandering in the Sinai desert and beyond, and how these needs were satisfied according to the Torah.

The Torah's accounts of wilderness water provision show both natural and miraculous sources at work. The first episode occurs a few days after the Exodus, when the Israelites complain of thirst at Marah, and the bitter water is miraculously sweetened by casting a certain tree into it (Exodus 15:22–25). Soon afterward, they arrive at Elim, where there are twelve springs, providing a natural source of water (Exodus 15:27). About one to two months after the Exodus, at Rephidim, the Israelites again complain of thirst, and Moses produces water by striking the rock in Horeb as ordered by God (Exodus 17:1–7). Decades later, in the fortieth year, the Israelites arrive at Kadesh in the wilderness of Zin, and Miriam dies (Numbers 20:1). The people complain of thirst, and Moses smites the rock rather than merely speaking to it as instructed, bringing forth water (Numbers 20:2-11, 13). Shortly afterward, at Beer, the Israelites receive water through digging under Divine guidance and human action (Numbers 21:16–18). In all these episodes, the water

was used not only by the people but also by their livestock (Exodus 17:3; Numbers 20:4, 11).[74]

Although the Torah does not explicitly name a well after Miriam, rabbinic tradition interprets the juxtaposition of Miriam's death with the subsequent water shortage at Kadesh (Numbers 20:1–2) as evidence that a miraculous "well" existed in her merit throughout the forty-year wandering. According to Talmudic and Midrashic sources (Talmud Taʿanit 9a; Numbers Rabbah 18:21), this well miraculously accompanied the Israelites throughout their wilderness encampments, appearing as needed at each station. These sources also suggest that the water from the well was drawn by the leaders of the people and distributed to the community, including their livestock, ensuring a continuous supply. The well ceased to flow upon Miriam's death, which explains the sudden water crisis at Kadesh. In this view, Miriam's well is regarded as the primary source of water for the Israelites, supplementing the natural springs and occasional miraculous interventions described in the Torah.

It should be noted that two narratives are interwoven here: the biblical narrative and that of rabbinic tradition. The written Torah describes several episodes of water provision: miracles at Marah and Rephidim, and a natural source at Elim, in the first days and months after the Exodus, followed decades later by another miracle at Kadesh and a natural source at Beer in the fortieth year. No explanation is given in the scriptural text regarding the water supply during the intervening four decades. It is no doubt for this reason that rabbinic commentators, apparently at a much later stage, introduced the idea of Miriam's well. This idea seems credible at first sight, but it must also be recognized that these overlapping narratives are not entirely harmonious. If Miriam's well was indeed present throughout the wanderings until her death, how are we to account for the repeated complaints of thirst recorded in the Torah narrative and the miracles performed by Moses in response?

Thus, based on the Torah and subsequent rabbinic readings of it, the roughly two million Israelites (not to mention the "mixed multitude" that accompanied them according to Exodus 12:38) and their livestock (explicitly mentioned in the text) were provided with sufficient water for their needs during the forty-year period of desert wandering, primarily by miraculous means — principally Miriam's mobile well, supplemented on occasion by Moses striking rocks — and finally by natural sources with Divine guidance. For our purposes here, the precise mechanism of provision is not critical; what matters is the quantity of water required daily over

74 Note in passing that the Hebrew terminology for "rock" differs in the said two accounts: *tzur* (צור, "rock/crag") in Exodus 17:6, and *sela'* (סלע, "rock/boulder") in Numbers 20:11. R. E. Friedman identifies the source of the first passage as E and that of the second as P.

forty years and the logistics of distributing it to such a large population, whose encampments must have been extensive and capable of accommodating both people and their animals.

My purpose here is not to deny miracles, but to visualize as clearly as I can what they would imply. When one reads the Torah accounts of Moses striking a rock and water miraculously gushing out, it seems, at first glance, easy enough to visualize. But once one begins to ask: how much water actually gushed out? how much would be required for two million people or more, not to mention their many animals? — the event becomes much more difficult to picture. Similarly, it is easy to simply claim that the people's needs were met throughout their forty years of wandering by means of Miriam's well; but how are we to imagine such a well moving with them from place to place? Was a borehole miraculously drilled anew into the ground at each station, or did a hologram of a well somehow fly alongside them when they marched and float in the air when they encamped? Did it draw upon pre-existing subterranean water, or was water created *ex nihilo* on an ad hoc basis? And what, in any case, would the practical logistics of supplying water from such a well actually have looked like?

For the purposes of this analysis, we take a rounded total population of approximately **two million Israelites**. In desert conditions, an average human requires roughly **3.8 liters of water per day** for basic survival, with higher amounts needed under strenuous activity or extreme heat. Applying this baseline to two million people yields a total **daily** consumption of approximately **7.6 million liters of water**, or about **7,600 metric tons**, for the human population alone. (Clearly, it would have been impossible for the leaders of the community to personally draw and distribute such a large quantity of water.)

A plausible camp density can be estimated by considering the need to cluster around water sources while allowing for movement and tents. At **5,000 people per square kilometer**, two million people would occupy roughly **400 square kilometers**, forming a square of approximately 20 kilometers on each side. At higher densities, for example **10,000 people per square kilometer**, the camp could fit into **200 square kilometers**, forming a square roughly 14 kilometers on each side. Within such a camp, distributing water efficiently from a single source would have been challenging but necessary. These figures provide realistic bounds for the size of a large temporary encampment rather than a sprawling settlement.

To estimate the human labor involved in water collection more realistically, we consider the structure of the population and household organization. Based on the previously established distribution of adults, children, and seniors, a total population of roughly two million would correspond to approximately **400,000**

households, assuming an average household size of five people. Using the estimated population structure — about 62 percent adults aged 20–60, 28 percent children under 20, and 5 percent seniors over 60 — a typical household would likely consist of one adult man and one adult woman, around 1–2 children, occasionally an older relative or grandparent, and possibly an adult child as a third adult. This reflects a somewhat tight but plausible arrangement for a nomadic or desert-wandering community.

For purposes of water collection, it is reasonable to assume that one able-bodied adult per household would be responsible for drawing the daily water supply, since infants and very young children cannot carry water, and very old adults may be incapable of doing so. This approach provides a practical framework for estimating labor without requiring every individual to fetch water. Supplying 7.6 million liters of water each day for the entire camp, using a typical bucket of 10 liters carried two at a time (20 liters per trip), requires 380,000 round trips per day. With 400,000 household representatives available to draw water, each one of them would need to make slightly less than one round trip per day on average, or about one trip per household with a small margin for spillage, inefficiency, or uneven distribution. In practice, many households would send their representative once daily, carrying two 10-liter buckets for a total of roughly 20 liters per household. This amount would suffice for minimal drinking needs, though it leaves little margin for additional uses. In principle, this is a manageable task for each household, but only under favorable conditions — namely, that access to the water source is reasonably uniform, that distances are not excessive, and that the task can be carried out efficiently despite the scale of the encampment and the harsh desert environment, and provided that the designated representative is consistently available and in sufficient health to perform the task.

In addition to the number of trips each household representative must make, the distance to a single central well would also impose a significant burden. For the walking-distance calculation, if we take a camp of 300 square kilometers, forming a square about 17 kilometers on each side, a household located near the center would walk only a short distance to the well, while a household near a corner would have to walk significantly farther. As a rough average, many households would need to walk about 4 kilometers to reach the well and then return with their water, for a round trip of about 8 kilometers. Assuming each household representative carried their two 10-liter buckets at a walking speed of about 4 kilometers per hour, the journey alone would take roughly two hours for such an average household. This does not include the time spent standing in line at the well, which would have been considerable given the large number of households. Even with many people

drawing water simultaneously, the logistics of distributing sufficient water across the entire encampment would have required sustained effort throughout the day.

From a practical perspective, even with only one household representative per family, walking about 4 kilometers each way with two buckets, standing in line, and transporting water throughout the camp demonstrates the substantial labor involved in supplying the Israelites' daily needs from a single central source. Considering the range of camp sizes discussed — from 200 km² to 400 km² — the distance to the central well could vary, and households at the periphery would walk considerably farther than those near the center, but the walking burden and logistical complexity remain significant across all realistic encampment scenarios. The calculations provide a clear picture of the physical effort required and the sheer scale of water logistics in a large desert encampment.

Concerning Sabbath observance in relation to water portage, we do not know whether the Israelites established a Sabbath ritual boundary (*eruv*) around their camps in the wilderness[75]. If they did not create an eruv, they would have needed to prepare water in advance for the Sabbath. If they did establish an eruv, they may have carried water on the Sabbath as on weekdays, or they may still have preferred to prepare water beforehand. Consequently, on some weekdays, more water than the standard 20 liters per household might have been carried. It should be noted that 20 liters of water weigh 20 kilograms — a substantial load that not everyone could manage over an average distance of 4 km in a single trip; some individuals would likely have needed to make two journeys. It should also be remarked that the Israelites could not draw water while on their short or long journeys through the wilderness, but would have needed to draw extra water in advance of each trip and carry it with them, using their reserves as required. Consequently, the labor of drawing and transporting water would at times have been far greater than usual, particularly during periods when the camp was on the move, compared with when the community remained in one location for an extended period.

On the assumptions outlined above, a single source supplying the camp — identified in later tradition as Miriam's well — would have needed to provide on the order of 7.6 million liters of water per day for the human population alone, amounting **over forty years** to **well over one hundred billion liters of water**. These figures give a sense of the sustained volumetric output that such a source

75 Assuming the Israelite camp covered between 200 and 400 square kilometers, its perimeter would have been roughly 57 to 80 kilometer**s** long. One might naturally ask, if a continuous boundary were required — such as for an *eruv* — where they would have obtained enough string or cord to stretch all around such a vast area.

would have had to maintain continuously over four decades. This, in turn, raises a further question regarding the nature of the water supply itself: was the water produced *ad hoc*, essentially created *ex nihilo* as needed, or was it drawn miraculously from a pre-existing natural, but otherwise inaccessible, extensive underground reservoir?

The water needs considered above, it should be noted, suffice only for the people's immediate bodily requirements. If one takes into account additional, domestic needs — water for cooking, for washing the body, for cleaning utensils, for laundering clothes, and similar uses — the total would necessarily be higher. Even under very austere conditions, such purposes would require at least **two to four times** the basic drinking requirement, and possibly more. The resulting figures would therefore need to be multiplied by a factor in that range.

From a comparative perspective, modern urban usage gives a sense of what people might consume under vastly different conditions: according to municipal and statistical data from Israel, typical household water consumption per person in an urban Israeli context is on the order of 150 liters per day or more. This includes not only drinking, but also bathing, cleaning, cooking, and other domestic uses. The water is supplied through a network of pipes and pumps, distributed to individual homes and buildings under pressure, rather than drawn manually from a well, and is treated to potable standards before reaching consumers.

So far, we have set aside the water needs of the Israelites' livestock, but the Torah makes clear that the people did in fact travel with significant numbers of animals. When the Israelites left Egypt, Scripture explicitly notes that they went up "with flocks and herds and very much cattle" (Exodus 12:38), indicating the presence of cattle, sheep, and goats as part of the migration. Various other passages throughout the Torah refer to these kinds of animals in contexts of sacrifice, herding, and domestic use (e.g., cattle in Exodus 9:3; sacrificial flocks in Leviticus 1–7 and Numbers 28–29). These references demonstrate that the community maintained a variety of domesticated animals over the course of their wanderings. We do not have data on the actual size of the stock, but for the sake of argument we can assume that each of the roughly 400,000 households mentioned earlier owned at least one animal. Suppose for illustration that about 30 percent of this assumed stock were cattle, 30 percent were goats, 30 percent were sheep, and 10 percent were camels[76]

76 This is hypothetical. Although camels are not mentioned in the Exodus narrative itself, they do appear in the plague account (Exodus 9:3), indicating their presence in Egypt. They might therefore have been used for transport; alternatively, donkeys — explicitly attested as domestic property (Numbers 16:15) — may have served that role. In terms of logistics, the average daily

— a mix reflecting common pastoral holdings in the ancient Near East. Using rough consumption figures from modern livestock water-use studies (cattle ~6 gallons/≈23 L per day; sheep/goats ~2 gallons/≈7.5 L per day; camels ~5 gallons/≈19 L per day, noting that camels may drink less frequently or more as conditions dictate) gives a very coarse estimate of daily water needs.

Under these assumptions, 120,000 cattle would require on the order of 2.8 million liters per day, 120,000 goats about 0.9 million liters, 120,000 sheep about 0.9 million liters, and 40,000 camels about 0.76 million liters — a total in the vicinity of **5.4 million liters per day** for the assumed animal stock. If the 'mixed multitude' also had animals, the total water requirement would be proportionately increased. Because this estimate depends on numerous uncertain assumptions about stock size, age, and use, it must be treated as speculative; nonetheless, even a conservative calculation suggests that the water needs of livestock could have been of the same order of magnitude as the people's own needs, and thus would have significantly increased the total water demand of the community.

In conclusion, the total daily water requirement for the Israelite community can be estimated by combining several components. The people's basic drinking needs amount to approximately 7.6 million liters per day. If we include domestic uses such as cooking, washing, and cleaning — roughly three times the basic requirement — this adds another 22.8 million liters, for a subtotal of 30.4 million liters per day. Adding the minimum estimated water needs of livestock, roughly 5.4 million liters per day, brings the total to approximately **35.8 million liters daily**. If the "mixed multitude" of roughly one million additional people mentioned in Exodus 12:38 (comprising roughly 200,000 additional households) is included, and eventually their livestock too, these figures increase by about fifty percent, raising the total daily water requirement to roughly 53.7 million liters. These calculations underscore the staggering scale of water that would need to be drawn, carried, and distributed each day to sustain both people and animals throughout the wilderness journey.

For purposes of illustration, the Israelites' basic daily drinking water needs of 7.6 million liters correspond to a continuous flow of roughly 88 liters per second, while the combined total including domestic uses and livestock, 35.8 million liters per day, corresponds to about 414 liters per second. For comparison, the Jet d'Eau in Geneva, Switzerland, expels roughly 500 liters per second, meaning the basic drinking requirement is about 18 percent of its output, and the total combined

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water consumption of the two is broadly comparable (when camel intake is averaged over several days), though camels generally require a greater quantity of fodder.

requirement is about 83 percent. Similarly, Europe's largest waterfall, the Rhine Falls near Schaffhausen, with an average flow of roughly 1,200 liters per second, would supply the basic drinking needs at about 7 percent of its flow and the total daily requirement at roughly 35 percent of its flow. This comparison helps to visualize the extraordinary quantity of water that would have had to be drawn, carried, and distributed daily to sustain the Israelites and their livestock throughout the wilderness journey. That's without including the "mixed multitude."

When one reads the Torah's account of water provision for the Israelites, as well as later commentaries on this subject, one does not immediately form a realistic picture of the enormous quantities involved — whether water is described as gushing from the rock or as being supplied from a well.

4. Cooking food in the desert

According to the Torah, the Israelites were principally fed, miraculously, with "manna" (Hebrew: מָן, *man*, from *man hu*, literally "what is it?") during almost forty years. This began as of: "the fifteenth day of the second month after their departing out of the land of Egypt" (Exodus 16:1), one month after the first Passover, and lasted throughout their travels: "And the children of Israel did eat the manna forty years, until they came to a land inhabited; they did eat the manna, until they came unto the borders of the land of Canaan" (Exodus 16:35). More precisely, the manna ceased just after Passover in the first year after crossing the Jordan River, as indicated in Joshua 5:10-12: "And the children of Israel… kept the Passover on the fourteenth day of the month at even… the manna ceased on the morrow after they had eaten of the old corn of the land; neither had the children of Israel manna any more…." Manna is described as follows: "there was a layer of dew round about the camp. And when the layer of dew was gone up, behold upon the face of the wilderness a fine, scale-like thing, fine as the hoarfrost on the ground" (Exodus 16:13b-14) — "and it was like coriander seed, white; and the taste of it was like wafers made with honey (Exodus 16:31).

We learn from Exodus 16:16 the quantity of manna each person needed: "Gather ye of it every man according to his eating; an omer a head, according to the number of your persons, shall ye take it, every man for them that are in his tent." An omer is a unit of volume, roughly 2.2–2.3 liters (often approximated as about 2.2 kg for a grain-like substance). Exodus 16:17-18 clarifies further: "And the children of Israel did so, and gathered some more, some less. And when they did mete it with an omer, he that gathered much had nothing over, and he that gathered little had no lack; they gathered every man according to his eating." As regards the Sabbath,

Exodus 16:22 specifies: “And it came to pass that on the sixth day they gathered twice as much bread, two omers for each one.” Exodus 16:23 tells us how the manna was prepared: “Bake that which ye will bake, and seethe that which ye will seethe.” Baking is cooking food by dry heat, typically in an oven or on hot stones, perhaps like pita bread, while seething refers to cooking in water, perhaps as a kind of porridge or stew. Numbers 11:8 adds that the people “ground it in mills, or beat it in a mortar, and baked it in pans, and made cakes of it.”

For manna to serve as the Israelites’ sole sustenance over forty years, it would have needed to be nutritionally complete, supplying adequate protein (including all essential amino acids), carbohydrates, fats, vitamins, minerals, and other needed substances. A healthy adult typically requires roughly 50 grams of protein per day, 2000–2500 kcal of energy primarily from carbohydrates, 30–70 grams of fat, sufficient vitamins and minerals (including salt), as well as fiber to aid digestion and water to maintain hydration. Manna would therefore have needed to provide these nutrients in roughly daily quantities to sustain health. A food as balanced and complete as manna would necessarily be miraculous, because no naturally occurring food, however rare, is ever that perfect.

At the Torah-given rate of one omer per person per day, each individual would receive 365 omers per year, and over a period of forty years a total of 14,600 omers. Extrapolated to a population of approximately two million men, women, and children, this amounts to 730,000,000 omers annually, and to an aggregate of 29,200,000,000 omers over forty years. If the “mixed multitude” accompanying the Israelites — assumed here to number a further one million people — is included, these figures increase by fifty percent. Even without attempting to convert these quantities into modern measures of weight or volume, the sheer scale involved is striking. The Torah does not specify whether the manna, including all the nutritive ingredients previously mentioned, was created *ex nihilo* (out of nothing) or whether it was drawn, in a miraculous manner, from materials already present in the natural environment.

The Torah indicates that other foods were not available in the desert, as highlighted by the complaints of the Israelites: “We remember the fish, which we were wont to eat in Egypt for nought; the cucumbers, and the melons, and the leeks, and the onions, and the garlic; but now our soul is dried away; there is nothing at all; we have nought save this manna to look to” (Numbers 11:5–6). This passage implies that manna alone had to meet all nutritional needs and underscores the absence of fish, vegetables, fruits, and other supplementary foods, in the Israelites’ diet. However, it is conceivable, in view of the mention in Exodus 12:38 of “flocks, and herds, even very much cattle,” that they also occasionally enjoyed milk and more rarely also meat. There is no evidence in the Torah that the Israelites brought

domesticated fowl with them into the desert, either for eggs or for meat. Yet from a cultural perspective, it seems unlikely that they would have traveled without some form of poultry, as fowl were a common part of household food supplies in the ancient Near East.

The Israelites were also, though only on two occasions, fed with quails (שלו, *selav*). The first time is reported in Exodus 16:13a: "And it came to pass at even, that the quails came up, and covered the camp." The second time is described in Numbers 11:18-20, 31-32: "18 and ye shall eat flesh; for ye have wept in the ears of Hashem, saying: Would that we were given flesh to eat! for it was well with us in Egypt… Ye shall not eat one day, nor two days, nor five days, neither ten days, nor twenty days; but a whole month, until it come out at your nostrils, and it be loathsome unto you…. And there went forth a wind from Hashem, and brought across quails from the sea, and let them fall by the camp, about a day's journey on this side, and a day's journey on the other side, round about the camp, and about two cubits above the face of the earth. And the people rose up all that day, and all the night, and all the next day, and gathered the quails; he that gathered least gathered ten heaps; and they spread them all abroad for themselves round about the camp." Two cubits equal about one meter. Quails are small birds, typically 16–20 cm long, yielding about 75 g of edible meat each. An adult could comfortably eat 4–5 quails in a single meal, though assuming a conservative average of 3 quails per person (to account for children and smaller appetites), feeding a population of 2 million people would require approximately 6 million quails in a single location on a single day. The sudden provision of such a massive number of quails in one location is indeed miraculous, far exceeding anything that could occur naturally even during normal migratory patterns. Presumably the quails were cooked, although the Torah does not specify how.

While in the wilderness, the Israelites' meat consumption was largely tied to sacrificial practices: animals were slaughtered for burnt offerings, peace offerings, sin offerings, and guilt offerings, with portions designated for the altar, the priests, or, in regulated cases, the persons who brought the offerings themselves. Sheep and goats are mentioned as flocks (Exodus 12:38; Leviticus 22:27), and cattle or oxen are referenced both for ritual use and transport (Numbers 7:3). Instructions make clear that slaughter for eating had to occur near the sanctuary, and all meat consumption had to comply with Torah laws regarding the treatment of blood. Outside these ritual contexts, there is no mention of the Israelites routinely killing their livestock for ordinary sustenance. Later, in Deuteronomy, the Torah permits slaughter for personal consumption within one's settlement, but initially in the desert, meat was consumed only under controlled, ritualized circumstances.

How did the Israelites cook their food? They certainly did not have modern technological conveniences like solar panels. In their day, cooking could only be done using fire from burning wood or oil. The Torah hints at the use of wood but makes no mention of oil, coal, or other fuel sources. In addition to the well-known account of a man gathering wood on the Sabbath (Numbers 15:32–36), the Torah mentions wood collection primarily in the context of ritual or service duties. In Numbers 4:7 and 4:9, wood is gathered as part of the transport and maintenance of the Tabernacle furnishings, while in Leviticus 6:12–13, priests are instructed to supply firewood for the continual burnt offering. Outside of these contexts, there are no passages in the Torah describing the collection of wood for ordinary daily use or subsistence purposes.

Where in a desert like the Sinai would millions of people find enough fuel for their daily food preparations? Even for minimal daily cooking, a person requires roughly 20 grams of fuel per day if using highly efficient stoves, or the equivalent energy from about 0.5 to 1 kg of dry wood if relying on traditional wood fires. For the Israelite population of 2,000,000 people, this translates to a total *daily* wood requirement of approximately 1,000,000 to 2,000,000 kg (1,000–2,000 metric tons), and that *during almost forty years*. If the "mixed multitude" (estimated by some at one million people) is included, this daily requirement would be increased by fifty percent.

Regarding the logistics of wood gathering, assuming the wood was readily available on the ground and could be gathered manually, the time required per individual would have been small. With an average wood-gathering rate of 15 kg per hour per person, collecting the daily wood for a household of five people — 2.5 to 5 kg — would take 10–20 minutes of continuous gathering per day, assuming optimal conditions. If the wood was dispersed across a camp covering 300 km², each of the 400,000 collectors would have an average statistical search area of about 750 m² — roughly a square patch of 27 m by 27 m. In practice, however, the wood would not be evenly distributed, and collectors would likely need to range far beyond their immediate patch, especially if the camp remained in one location for multiple days[77]. Walking through the surrounding terrain at 5 km/h (1.39 m/s) and scanning for suitable wood, the daily collection time could easily rise to 20–40 minutes per day per household.

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77 The Torah does not give fixed durations for the Israelite encampments at each station in the Sinai/wilderness itinerary. From the narrative as a whole, the stays at individual stations likely ranged from a few days to several months. One notable exception is the prolonged period associated with Kadesh, where the Israelites remained (in that region) for much of the 38-year wandering described in Book of Numbers.

The point of this analysis is to show the implausibility of any suggestion that enough wood could be found in a wilderness setting like Sinai to meet the daily needs of two million people or more — namely, a total daily requirement of 1,000,000 to 2,000,000 kg (1,000–2,000 metric tons) of wood. For a population of this size, the requirement would correspond to roughly 4,000–8,000 medium-sized trees every single day, assuming each tree yields about 250 kg of usable firewood. Trees in the Sinai such as acacia and tamarisk would have been typical sources. Extrapolated over forty years, this implies a staggering need for approximately 58–117 million trees. Even in a forested region, harvesting and transporting this many trees daily would be a massive undertaking; in the sparse, arid environment of the Sinai desert, where wood is scarce and dispersed, if found at all, it becomes virtually impossible to locate and collect such quantities on a daily basis for forty years, highlighting the sheer logistical absurdity of expecting the Israelites to obtain enough wood for their daily food preparations.

From a literary-critical perspective, it is very significant that the author(s) of the narrative of desert wandering did not address this "little" problem of wood supply — anymore than they addressed the "little" problem of water supply. The Torah does not mention these issues or how they might have been resolved. It could have stated, credibly, that these problems were solved miraculously, as the problem of food supply was through the manna narrative; yet it seems the author(s) did not reflect on these matters, leaving a conspicuous practical gap in the story.

Another similar problem that seems to have been overlooked is the feeding of the livestock the Israelites brought with them into the wilderness. Even assuming as a minimum a single animal per household — as we did previously when considering water needs — this amounts to roughly 400,000 animals. It is difficult to see how they could have been fed in the Sinai desert, a region with very sparse vegetation. Even today, the small populations of Bedouin maintain relatively few animals in this desert, and there is certainly not enough grass at any season, let alone throughout the year, to sustain large flocks and herds.

In the Middle Eastern environment, the dietary needs of domesticated animals vary according to species and available vegetation. Cattle, which require substantial quantities of long grasses, consume roughly ten kilograms of dry fodder per day. Goats and sheep are more adaptable: goats browse on shrubs, leaves, and shorter grasses, consuming about four kilograms daily, while sheep prefer short grass and require approximately three and a half kilograms per day. Camels, well adapted to desert conditions, can subsist on coarse shrubs, thorny bushes, and dry twigs, typically eating around nine kilograms per day. Applying these figures to a population of four hundred thousand animals — divided for the sake of argument

into 30% each of cattle, goats, and sheep, and 10% camels — yields a staggering requirement of approximately 2,460 metric tons of fodder per day. Over a period of forty years, this totals nearly 36 million metric tons.

The natural vegetation of the Sinai, however, is (and no doubt also was in antiquity) overwhelmingly desert, with only sparse shrubs, seasonal grasses, and limited oases or wadi bottoms capable of supporting livestock. Even the most productive semi-arid rangelands could sustain perhaps one large ruminant per hectare annually, meaning that the region could not conceivably provide sufficient fodder for hundreds of thousands of animals over decades. At best, a few thousand animals could survive for short periods on naturally available vegetation. These calculations indicate that the maintenance of such a large population of livestock in the Sinai, without supplemental fodder or extraordinary intervention, would be ecologically impossible. Any scenario in which all 400,000 animals subsist in that wilderness for extended periods would therefore require either extensive human provisioning from elsewhere (and there was nowhere for that) or, as the narrative must be taken to imply, miraculous support.

Once again, the reader is left nonplussed, wondering how the author(s) of the narrative did not take this significant problem into account and suggest some sort of solution for it.

The omissions highlighted here suggest that the narrator's interests were theological rather than practical. The narrator selects emblematic episodes rather than presenting a fully specified and credible survival economy. The "unasked" questions about water, fuel, and fodder illustrate how, when the text is read with modern demographic, ecological, and thermodynamic sensibilities, the world it depicts appears under-specified. This under-specification can be interpreted in several ways: as evidence that the story is a primarily symbolic-didactic composition, unconcerned with environmental realism beyond what serves its theological aims; or, more traditionally, as an invitation to view the entire wilderness period as pervaded by ongoing, taken-for-granted miracles extending beyond what is explicitly narrated; or, in more minimalist historical reconstructions, as a sign that later hyperbolic expansions of numbers and duration outgrew an original narrative's more modest experiential base. The latter hypothesis seems the most probable, though the safest assumption is that some truth may be found in each of these perspectives.

5. The demise of the former slaves

We shall now study some implications of the decree in **Numbers 14:28-33**:

> **14:**28 Say unto them: As I live, saith Hashem, surely as ye have spoken in Mine ears, so will I do to you: 29 your carcasses shall fall in this wilderness, and all that were numbered of you, according to your whole number, from twenty years old and upward, ye that have murmured against Me; 30 surely ye shall not come into the land, concerning which I lifted up My hand that I would make you dwell therein, save Caleb the son of Jephunneh, and Joshua the son of Nun. 31 But your little ones, that ye said would be a prey, them will I bring in, and they shall know the land which ye have rejected. 32 But as for you, your carcasses shall fall in this wilderness. 33 And your children shall be wanderers in the wilderness forty years, and shall bear your strayings, until your carcasses be consumed in the wilderness.

Rabbinic interpretation notes that the "forty years" are reckoned from the Exodus itself, so that only thirty-eight years remained after the decree; indeed, the period of the punishment is explicitly given as thirty-eight years (Deuteronomy 2:14), since two years had already elapsed prior to the decree (Sifre Devarim 26).

As previously noted, the first formal census in the wilderness (Numbers 1) counted Israelite males "from twenty years old and upward," commonly understood to include men capable of military service, i.e. those up to roughly sixty, yielding a total of 603,550 (Numbers 1:46). The Levites were counted separately, giving an estimated combined total of about 617,130 males aged 20–60. In our broader demographic reconstruction, however, we have already taken into account those outside this census category, including men over sixty, estimating them together with women and children as part of a total population of roughly 1.8–2.0 million.

Classical Jewish sources clarify that the Divine decree of Numbers 14:28–33 was not understood to apply uniformly to all segments of the population. Women were explicitly excluded from the decree, as stated in BT Sotah 11b, which affirms that they did not participate in the sin of the spies and therefore were not subject to the punishment; this view is echoed in other sources such as Midrash Tanchuma Pinchas 7. The Levites, though not explicitly exempted in the biblical text, are generally understood to have been excluded from the decree by implication: as explained by Rashi on Numbers 14:29 (and similarly by Ramban *ad loc*.), the decree applies to "all who were counted," i.e., those included in the military census of Numbers 1, from which the Levites were expressly omitted. By contrast, there is no clear rabbinic statement excluding men over sixty from the decree, and they may therefore be presumed to have been included. In any case, those aged 60+ at the time would have been 98 or older by the time of entry into the Promised Land, and it is therefore likely that most would have died naturally in the interim. Thus,

in traditional interpretation, the decree is directed primarily at the adult male, non-Levite population of the Exodus generation, with women explicitly exempted.

Consequently, we can note that, when the Israelites were poised to enter the Promised Land thirty-eight years later, those aged 0–38, whether male or female, had all been born during the years of wandering following the decree; those aged 38–58 had been 0–20 at the time of the decree and were therefore not subject to it; and — except for Levites — no males who had been 20–60 at the time of the decree are left alive, having perished during the intervening period. Many women in that age group, being exempt from the decree, may well have survived. Additionally, some individuals aged 60+ at the time of the decree may have survived into the period of entry — particularly among women, and possibly among men as well if they are considered outside the scope of the decree — though such survivors would by then be of very advanced age (that is, 98+). Joshua and Caleb are, of course, explicitly named as survivors, irrespective of their ages.

The second census recorded in Numbers 26, like the first census in Numbers 1, explicitly excludes the Levites, who are counted separately due to their distinct role in sanctuary service. The main census enumerates the Israelite males 20+ years old by tribal affiliation, yielding a total of 601,730 men (Numbers 26:51), while the Levites are registered independently (Numbers 26:57–62) and therefore not included in this figure. When compared with the first census of 603,550 non-Levite Israelite males, the overall population of military-age men thus remains remarkably stable over the intervening period, with only a slight decrease of 1,820 individuals. This near equivalence reflects the complete generational turnover mandated by the decree of Numbers 14:28–33: the original adult cohort perished in the wilderness, apart from Joshua and Caleb, and was replaced by those who had been minors at the time of the decree together with those born during the subsequent decades. From the nature of the decree itself, it may be inferred that the population at the time of the second census contained relatively few elderly men in comparison with a stable, approximately bell-shaped (normal) age distribution, since those who had been adults at the time of the decree did not survive into advanced age.

At the time of the decree in Numbers 14, the Israelites were encamped at Kadesh-Barnea, on the southern edge of Canaan, with the spies having just returned from the reconnaissance of the land. Following the judgment, they did not proceed northward but instead turned back into the wilderness, wandering for the remainder of the period within a broad southern desert belt adjacent to Canaan, with Kadesh serving at times as a recurrent base.

Both rabbinic tradition and modern scholarship locate this wandering within the same general region, though modern reconstructions provide the most concrete

geographic framing. The encampment at Kadesh-Barnea is generally identified with the northeastern Sinai / southwestern Negev, near the border of settled Canaan. From there, the Israelites are associated with movement across the wilderness of Paran, typically understood as covering much of the northern Sinai Peninsula and adjoining southern borderlands, and the wilderness of Zin, usually placed in the eastern Negev toward the Arava/Dead Sea corridor. In modern scholarly reconstructions, these designations are not sharply bounded localities but overlapping desert zones forming a contiguous corridor between northern Sinai, the southern Negev, and the western edge of Edom, within which the Israelites' movements during the forty-year period are understood to have taken place.

The Sinai Peninsula can be conceptualized as part of a broader, roughly triangular landform extending into the southern Levant, on a purely geographic reading that disregards modern political borders. Its northern side runs from the eastern edge of the Nile Delta region in Egypt along the Mediterranean coast, passing through the Beersheba–Arad region to the Dead Sea basin. Its eastern flank descends through the Negev and the Arava Valley to Eilat along the Gulf of Eilat and on to Sharm el-Sheikh; this line largely follows a major fault line where two blocks of the earth's crust slide past each other, rather than marking a simple outer edge of the land. Its western flank follows the arc of the Gulf of Suez from the area north of Ismailia down to the same southern apex, corresponding to a natural boundary formed by the same geological forces that created the Red Sea. This is why, in the biblical narrative, a significant amount of the action takes place in the Negev desert region, which — on a broader geographic reading — can be seen as part of the same wider Sinai–southern Levant desert system, even though it is often regarded today as a separate region.

If a very large population had sojourned and moved within the southern desert belt over an extended period, one would expect, in principle, to find archaeological traces consistent with sustained and repeated human presence. These might include successive occupation layers at encampment sites, accumulations of material culture such as pottery sherds and animal remains, and evidence of hearths and refuse disposal. However, food remains would not be expected as they usually are, since the Israelites are described in the Torah as consuming manna, nor would installations related to water procurement such as wells or cisterns, since they are understood to have depended on Divinely provided water sources (principally, according to later traditional accounts, Miriam's well). In any case, a mobile population living in a relatively frugal, close-to-nature manner in an arid environment would be unlikely to leave extensive, durable settlement remains.

By contrast, one category of evidence that archaeologists would most strongly expect to find is ***funerary remains***. Given the scale of the population and the passage of time, the hundreds of thousands of deaths recorded over the period would, in principle, have required burial, and such burials should leave clusters of graves or cemeteries within the region. The decree concerns a very large, well-defined mortality: approximately 603,000 adult males. When combined with natural mortality across the broader population over the 38 years, total deaths plausibly reach on the order of about 1.3 million individuals. Note that the Israelites were a people who buried their dead (Exodus 14:11, Numbers 11:34).

The itinerary in Numbers 33 lists roughly forty named encampment stages across the entire journey, but only one subset of these corresponds to the post-decree wandering period following Kadesh-Barnea. Excluding the pre-decree stages, the number of encampments relevant to the 38-year period is substantially smaller; a reasonable estimate is on the order of about thirty post-decree encampments. Using this as a rough proxy for major stopping points, distributing ~1.3 million deaths across ~30 encampments yields an average of approximately ~40,000–45,000 deaths per encampment.

This does not mean that each location would necessarily contain a single, uniform cemetery of that size. Rather, deaths would have occurred over time within each successive encampment, with variation in duration of stay and population density, producing a non-uniform distribution. Longer-term or recurrent encampments — such as central or repeatedly visited locations like Kadesh-Barnea — would be expected to accumulate disproportionately larger numbers of burials, while shorter stops would correspond to smaller totals. In such contexts, it is also possible that some graves may have been marked in ways consistent with customary burial practices, potentially including simple stone markers or other forms of identification, although the text itself does not specify such details.

A more realistic model, then, is one in which each major post-decree encampment is associated with multiple burial clusters, ranging from smaller groups of graves to larger concentrations, collectively amounting to thousands and in some cases potentially tens of thousands of interments over time. Even allowing for such variation, the overall scale implied by the narrative suggests that identifiable cemetery clusters should exist within the broader desert corridor of the Sinai Peninsula and the Negev Desert. The relevant expectation is therefore not a uniform distribution of graves across the landscape, but the presence of concentrated burial zones associated with principal encampment areas — features that, if they survive in detectable form, could potentially be identified through systematic archaeological survey and modern remote sensing methods.

Extensive surveys conducted so far across the northern Sinai, the Negev, and adjacent regions — including areas associated with Kadesh-Barnea — have documented archaeological remains, but these consist primarily of small, dispersed, and often short-term occupations[78]. The material evidence recovered in these regions is consistent with nomadic or semi-nomadic activity, seasonal encampments, trade routes, and, in some periods, minor fortifications or administrative installations. Such findings indicate human presence, but not the kind of sustained, high-density occupation that would be expected from a very large population over multiple decades. What has not been identified, to date, are large cemeteries or burial clusters datable to the relevant period that could plausibly correspond to the scale of mortality implied by the narrative, nor are there associated patterns of dense, repeated occupation that would indicate prolonged aggregation of very large populations within specific localities.

Accordingly, the available archaeological record is generally taken to reflect intermittent and relatively low-density human activity in the Sinai–Negev–Arava corridor during the relevant horizon. At the same time, interpretations necessarily remain cautious, since desert environments and mobile patterns of subsistence tend to leave limited and uneven traces in the archaeological record. Moreover, the detection of funerary landscapes and other subtle features is an area in which ongoing advances in survey techniques, including high-resolution remote sensing, geophysical methods, and improved ground-truthing strategies, may in the future reveal evidence that is not currently visible or has not yet been systematically identified. Conclusions are therefore framed in terms of the kinds of material evidence that are presently detectable, while acknowledging that future technological developments may refine or expand the evidential picture.

Inductive logic holds that, among competing hypotheses at a given stage of inquiry, the one supported by the strongest empirical evidence — both qualitatively and quantitatively — is the most likely to be true and is therefore to be preferred, provided, of course, that all appropriate research practically possible at the time has been carried out with due skill and diligence. Accordingly, inductive logic recognizes that the paucity or absence of concrete evidence does not, by itself, definitively disprove a theory, since new lines of inquiry or improved methods may emerge at a later stage. This allows proponents of the Exodus narrative to remain

78 For surveys of northern Sinai and the Negev, see Eliezer D. Oren (ed.), *The Archaeology of Northern Sinai* (Philadelphia: University of Pennsylvania Press, 1987); and for Kadesh-Barnea (Tell el-Qudeirat), see Rudolph Cohen, "Excavations at Kadesh-Barnea (Tell el-Qudeirat) 1976–1982," *Israel Exploration Journal*, and subsequent reports in Israel Antiquities Authority publications.

hopeful, since advances in technology may yet enable the discovery of clear evidence of large numbers of graves in the relevant region and period, which would constitute particularly compelling support for the historical presence of such a population.

7. THE ISSUE OF HISTORICITY

1. The case for smaller numbers

In view of the foregoing findings relating to the Books of Exodus and Numbers — especially the account of forty years of wandering in the Sinai wilderness, which offers no clear explanation of how the water and fuel needs of two or more million people, or the fodder requirements of their livestock, were met — the Torah narrative of the Israelites' exodus from Egyptian bondage is open to serious doubt, whether one welcomes this conclusion or not. Such doubt is further heightened by the practical complexities inherent in the account of the miraculous splitting of the Red Sea, as well as by the absence, to date, of archaeological evidence for the demise and burial of a population exceeding a million people in the region concerned, broadly encompassing northern Sinai and the Negev. In any case, one cannot reasonably claim that the Torah as a whole is certainly literally true, since, as argued earlier, many of the principal narratives in the Book of Genesis lack scientific and/or historical credibility.

Many modern commentators, including Jewish and even Israeli ones, have, on the basis of such difficulties, come to reject outright the Torah narrative of the exodus and the wilderness wanderings, not to mention the subsequent conquest of the land. The implications of such a sweeping denial are, of course, far-reaching, primarily from a spiritual and religious perspective, but also, in the present context, apparently from a political one. The stakes are therefore high. The Jewish religion is largely founded on this narrative, for it is within it that the Torah is presented as having been given to the Jewish people, transforming them from hopeless slaves to matter (symbolized by their Egyptian bondage) into free men and women dedicated to the spiritual service of Hashem. As regards the political significance, however, this is less troubling than it may initially appear, since it is impossible to reasonably deny the well-established historical fact, supported by substantial material evidence, that the Jewish people (as Hebrews, Israelites, Judeans, or Jews) have lived for millennia in the Holy Land. The question at issue is not this continuity of presence, but rather whether they were already an indigenous population (aborigines — or earlier migrants from the east, as the Abraham narrative suggests), cohabiting the land with various so-called Canaanite groups, or whether they (or many but not all of them) were relative latecomers, ex-slaves arriving from the west, and foreign conquerors of the land (eventually taking over all of it).

One is tempted, in an effort both to acknowledge the aforementioned narrative difficulties and to avoid the more explosive implications of outright rejection, to retain the essential features of the Torah narrative — a large group of slaves miraculously freed, receiving the Torah, and eventually reaching and conquering the Promised Land — while adjusting the quantitative values of the relevant variables. Thus, the demographic scale may have been smaller than reported, and/or the distance travelled and time taken may likewise have been less than traditionally supposed. Adopting such hypotheses would, of course, imply that the Torah narrative is not exclusively and entirely of Divine origin, but is at least in part the product of human authorship, whether at its inception or through later editorial activity (especially hyperbole). This inference, however, may not appear as shocking today as it would have in earlier periods, given the considerable body of modern biblical scholarship that has highlighted the textual, literary, historical, and related source-critical, form-critical, and redaction-critical issues, as well as the resulting tensions within the traditional framework.

Let us first consider the demographic variable. According to the two wilderness censuses recorded in the Book of Numbers, the totals for each tribe are as follows. In the first census (Numbers 1), excluding Levi: Reuben 46,500; Simeon 59,300; Judah 74,600; Issachar 54,400; Zebulun 57,400; Ephraim 40,500; Manasseh 32,200; Benjamin 35,400; Dan 62,700; Asher 41,500; Gad 45,650; Naphtali 53,400 — making a total of 603,550. The Levites, who were counted separately (Numbers 3:39), numbered 22,000 males (from one month old and upward). In the second census (Numbers 26), again excluding Levi: Reuben 43,730; Simeon 22,200; Judah 76,500; Issachar 64,300; Zebulun 60,500; Ephraim 32,500; Manasseh 52,700; Benjamin 45,600; Dan 64,400; Asher 53,400; Gad 40,500; Naphtali 45,400 — yielding a total of 601,730. The Levites, again counted separately (Numbers 26:62), numbered 23,000 males (from one month old and upward).

It is worth observing that almost all these figures are round numbers ending in “00” (when expressed in Arabic numerals – the Torah, of course, states them in words). This amounts, across the two censuses (including the Levite figures), to twenty-four occurrences of double zero in succession. The only exceptions are, in the first census, Gad at 45,650, and in the second census, Reuben at 43,730; and both of these figures end in a single zero. This pattern is difficult to reconcile with the expectation of exact statistical reporting (Rashi on Numbers 1:1, Bamidbar Rabbah 2:19). The probability that a given number ends in “00” (rather than any of “01”–“99”) is 1/100; accordingly, the probability that twelve independent numbers all end in “00” is $(1/100)^{12} = 10^{-24}$, and for twenty-four such numbers $(1/100)^{24} = 10^{-48}$. In other words, ***the probabilities are very close to zero*** (under random conditions).

I have argued elsewhere that such rounding may reflect the censuses' practical, military purpose: their primary concern may have been to determine how many units of one hundred fighting men (companies) could be formed, rather than to record precise headcounts. A unit of one hundred would remain operational as such even if a small number of its members were temporarily incapacitated through illness or injury, or permanently lost due to natural causes or in battle. While this rationale does not account for the noted two exceptions, it nevertheless offers a plausible and coherent explanation. However, this hypothesis does not account for the Levite figures, which also end in "00," even though they were not enumerated for military purposes.

But there is a less apologetic and more skeptical way of accounting for these unlikely round numbers. It is conceivable that the original figures were smaller by a factor of one hundred and were subsequently amplified in an élan of hyperbole, with the couple of non-rounded exceptions reflecting either an attempt to lend verisimilitude or the result of later scribal irregularities. On this view, the number of Israelites (men, women, and children) who departed from Egyptian bondage would have been closer to **20,000** than to 2,000,000, with the tribal figures likewise reduced proportionately. The tribal figures, for males in the specified age ranges, in the two censuses, when divided by one hundred and rounded to whole numbers, would then be as follows. First census: Reuben 465, Simeon 593, Gad 456, Judah 746, Issachar 544, Zebulun 574, Ephraim 405, Manasseh 322, Benjamin 354, Dan 627, Asher 415, Naphtali 534; Levites 220, total about 6255. Second census: Reuben 437, Simeon 222, Gad 405, Judah 765, Issachar 643, Zebulun 605, Manasseh 527, Ephraim 325, Benjamin 456, Dan 644, Asher 534, Naphtali 454; Levites 230, total about 6247.[79]

A founding population of 36 men growing to 6,255 individuals over 210 years implies an average annual growth rate of approximately 2.46%, while growth from 36 to 617,000 over the same period would require roughly 4.63% per year. Both rates are exceptionally high in demographic terms. For comparison, ancient agrarian societies such as Egypt and the wider ancient world typically experienced long-term growth rates on the order of 0.05% to 0.2% per year, with even short-lived expansions rarely exceeding about 0.3–0.5%. By contrast, modern global population growth peaked at roughly 2% per year in the 20th century, driven by

79 I write "about" for the totals because the age range for Levites is different from that of Israelites. As already pointed out, the numbers are, in the Torah, expressed in words, not in Arabic numerals. If they are divided by a hundred, the wording would necessarily change. For example, the tribe of Reuven in the first census is numbered at "forty and six thousand and five hundred" (Numbers 1:21); dividing this figure by a hundred would yield "four hundred and sixty-five."

industrialization, improved nutrition, and medical advances, but has since declined in most regions. Thus, both scenarios imply growth rates far above those characteristic of pre-modern populations and comparable only to or exceeding the upper limits of modern demographic expansion. However, the reduced-numbers scenario is, on demographic grounds, clearly more plausible than the larger biblical figures, even though it too remains highly exceptional by historical standards.

Such a hypothesis may strike one as unduly reductive, diminishing the drama and grandeur of the exodus narrative. Yet it has the advantage of rendering the account more naturalistic and plausible, insofar as the logistical demands — water, food, fuel, and fodder — would thereby, being all accordingly divided by a hundred, be brought within more credible limits[80].

Secondly, let us consider the variables of distance and time. The Sinai Peninsula has a roughly triangular shape, widening toward the Mediterranean in the north and narrowing toward the Red Sea in the south. It is approximately 210 km wide along its northern Mediterranean coast, about 130 km wide at its southern apex near the tip between the Gulfs of Suez and Eilat, and roughly 400 km in length along its central north–south axis. A column of people, including men, women, children and elderly, accompanied by animals, marching at an average pace of about 2 km an hour for 5–7 hours per day (10–14 km per day), and resting one day a week (the Sabbath), would therefore cover an effective average of approximately 8.6–12.9 km per day, and could traverse its widest west–east span in approximately 16–25 days. By contrast, a maximal perimeter route following the Gulf of Suez coast down to the southern tip and then ascending the Gulf of Eilat to the opposite corner, covering a total distance of, say, 600 km (reflecting the highly irregular and indented nature of the two gulf coastlines), would extend the journey to approximately 47–70 days under the same conditions.

From these calculations, it follows that a column of Israelites could have traversed the Sinai in a relatively short period of time — at minimum about two weeks and at maximum about ten weeks — excluding a pause of at least several days, or

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80 It is interesting in this context to note the interpretation in the Mekhilta de-Rabbi Yishmael (cited by Rashi) of the statement in Exodus 13:18 that "the Israelites went up armed" (*ḥamushim*). On this reading, *ḥamushim* is taken not only in its literal sense of "armed," but also as a cryptic numerical allusion to the proportion of Israelites who actually left Egypt. The Midrash records several alternative estimations: one view holds that only one in five of the Israelites survived the plague of darkness and departed; another suggests one in fifty; and yet another, as few as one in five hundred. The remaining population is said to have perished during the three days of darkness. If anything, this commentary illustrates the flexibility of traditional exegetes with population estimates.

perhaps a couple of weeks, for the Revelation at the foot of one of the higher mountains of the peninsula. This hypothesis would greatly ease the logistical problems of water, food, fuel, and fodder supply, whether the migrants are taken to have numbered two million or, *a fortiori*, twenty thousand, since they could have taken with them a lot of what they would need for their journey. Of course, a journey lasting only one to three months would leave little time for some of the episodes reported in the biblical narrative; these would therefore have to be considerably compressed or else regarded as later narrative elaborations.

The identity of the mountain location where the Torah was given to the Israelites is disputed, with numerous different places proposed. Within the Sinai Peninsula itself, the dominant traditional identification is Mount Sinai, commonly associated with 'Jebel Musa' in the southern Sinai Peninsula (near where Christians much later built St Catherine's Monastery). This identification is often linked with the nearby plain of er-Raaha as a possible assembly area at the foot of the mountain, though its limited and uneven terrain has also been noted in discussions of the feasibility of large-scale encampment. Other proposals within Sinai include nearby peaks in the same southern massif, such as 'Jebel Catherine', and alternative southern candidates like 'Jebel Serbal', the latter sometimes favored on account of the more extensive surrounding valley system of Wadi Feiran. A smaller number of central or northern Sinai identifications lack the same continuous historical tradition, while a further set of proposals locates Mount Sinai in the Negev region; some hypotheses, moreover, place it outside Sinai altogether, in the north-western Arabian Peninsula.

According to the chronology in Exodus, the Israelites remained at Mount Sinai for about one year less ten days, from their arrival in the third month after the Exodus (Exodus 19:1), until their departure in the second month of the second year (Numbers 10:11), after the inauguration of the Tabernacle (*Mishkan*). This corresponds to approximately 11 months (roughly 300–340 days), though the text does not give a precise day count. The initial Sinai revelation (the Ten Commandments) occurred shortly after arrival, following a three-day period of preparation (Exodus 19:10–16), while Moses subsequently undertook two forty-day ascents of the mountain (Exodus 24:18; 34:28), associated with the reception of further laws and the covenant renewal. The materials for the Tabernacle were gathered and the work began soon after Moses returned from Sinai with the second tablets (Exodus 34–35). The biblical text does not specify how long it took to construct the Tabernacle, but it is generally inferred from the narrative sequence that its construction occupied only a few months within the overall Sinai period.

Of course, if only a few days are assumed for the revelation in our accelerated Sinai crossing scenario, then the narrative of Moses' two "forty days and nights" vigils on the mountain (Exodus 24:18; 34:28) would have to be considerably shortened — say, by removing a zero, to four days and nights at a time, which would in any case be a more realistic duration for someone fasting. Likewise, the account of thirty-eight years of Divinely imposed wilderness wandering following the episode of the spies would have to be drastically reduced or even eliminated — thus incidentally solving the problem of missing graveyards. Such substantial editorial reductions, quantitative and/or narrative, may seem philistine, but the aim here is simply to envisage a minimalist narrative — with fewer people, shorter distances, and less time taken — in order to preserve *the core account of a collective exodus from Egypt and a journey to the Promised Land*, which logistical and other considerations otherwise render implausible. There is no hostile or polemical intent in such a reconstruction; on the contrary, its purpose is constructive — namely, to avoid the conclusion, which some readers draw, that the biblical narrative is merely legendary.

For me, the most convincing evidence that some Jewish people were at one time enslaved in Egypt and subsequently escaped and returned through the Sinai to their promised homeland and conquered it is the simple fact that this tradition is asserted within Judaism itself and made one of its central tenets. For why would any people wish to commemorate and transmit a collective memory of slavery? Peoples typically preserve narratives of triumph and glory rather than of humiliation or defeat. And why would a native people pretend to have been foreigners (even if with some ancestral roots) who conquered their land? Peoples all know that natives have more right to a land than foreign invaders. The Jews could, in principle, have constructed a more flattering account of their origins and ownership, yet they instead preserved and transmitted this difficult narrative. The religious motivation for this tradition is, of course, the belief that the Exodus represents Divinely-assisted liberation from Egypt and conquest of Canaan, and that the continued remembrance of these founding events serves as an expression of praise and thanksgiving to God. Yet other, more ego-enhancing alternatives could have been adopted — but were not. On this basis, the tradition carries considerable prima facie credibility as unadorned truth. Nevertheless, we must acknowledge that certain elements of the account remain difficult to accept in light of their empirical and logical difficulties, and endeavor to resolve the issues they raise.

2. Contemporary views

For purposes of contrast, the following brief exposition is intended to acquaint the reader with *contemporary secular scholarship* on the origins of the Hebrew people. It is not my intention to subscribe to or endorse this narrative, for in my view some of it appears speculative and some of it ideologically motivated. Nevertheless, much of it is based on serious archaeological and documentary research and is therefore worth getting acquainted with. While the biblical Exodus narrative portrays a dramatic migration from Egypt, there is no explicit evidence of such an event in extant Egyptian records or in known archaeological remains.

Most modern scholars consider that the early Israelites emerged gradually within Canaan itself, rather than arriving as a large foreign group. Archaeological evidence from the central hill country of Canaan shows the appearance of numerous small settlements in the late second millennium BCE (c. 1300–1100 BCE), often in previously sparsely populated areas. The material culture of these settlements — pottery styles, architectural forms, and agricultural tools — remains largely Canaanite, indicating that the inhabitants were indigenous rather than outsiders. Linguistic evidence supports this view: Hebrew is one of the Canaanite languages, closely related to Phoenician and Moabite, reflecting continuity with local Semitic traditions. By 1208 BCE, the Merneptah Stele already mentions Israel as a people living in Canaan, confirming their presence in the region.

At the same time, the biblical narratives preserve a folk memory of eastern origins, reflected both in the stories of Abraham migrating from Mesopotamia (Ur/Haran) and in the very name Ivri (Hebrew), which suggests "one from beyond [the Jordan]." Scholars reconcile this by suggesting that such traditions may preserve memories of small groups or lineages who migrated westward, gradually merging with local Canaanites, while the narratives themselves became central to Israelite identity and collective memory. In this way, the Israelites were largely indigenous in origin, yet the eastern origin tradition provided a symbolic framework for social, religious, and cultural cohesion, preserved and expanded in the biblical texts.

Adding complexity, the Documentary Hypothesis shows that the Torah contains multiple sources — J (Yahwist), E (Elohist), P (Priestly), and D (Deuteronomist) — distinguished, among other features, by the names of God they use (YHWH versus El/Elohim). These divergent traditions suggest that early Israelite identity was composite, reflecting different tribal and regional memories, rather than a single unified origin. The archaeological evidence of highland settlements, the folk memory of Abraham, and the textual evidence of multiple sources thus converge to

indicate that early Israelite identity was gradual, syncretic, and regionally diverse, even as later authors framed it in a coherent narrative.

Over time, these communities gradually developed distinctive religious practices, social structures, and cultural institutions that distinguished them from their Canaanite neighbors. Early Israelite religion appears to have evolved from the broader West Semitic milieu, incorporating elements of ancestor veneration, highland cultic sites, and gradually centralizing worship around Yahweh. This evolution was incremental, reflecting both local innovation and selective retention of older traditions, including memories of Abraham and other patriarchs. By the Iron Age, these processes had produced a cohesive cultural and religious identity, later codified in written form in the biblical texts, giving expression to a shared history, law, and covenantal theology.

Archaeological excavations of early Iron Age villages in the central highlands of Canaan — often associated with the earliest Israelites — have revealed a striking pattern: animal remains contain almost no pig bones, whereas pork consumption is common in nearby Canaanite and Philistine sites. While environmental factors may partly explain this difference, many scholars regard the consistent avoidance of pork as an early cultural marker of the communities that would later become the Israelites. Other recurring features strengthen this identification, including the four-room house layout typical of these settlements and the absence of Canaanite cultic objects, suggesting distinct social and religious practices.

Taken together, these archaeological markers — four-room houses, avoidance of Canaanite cultic objects, and systematic abstention from pork — provide a coherent picture of the proto-Israelite communities in the highlands. Gradually forming a distinct identity within the broader Canaanite cultural milieu, these groups developed the language, religion, and social structures that would become central to Israelite civilization. The biblical narratives preserved both symbolic memories of eastern origins (Ivri and Abrahamic migration) and the codified expression of evolving cultural identity, which set the stage for the emergence of the Hebrew language as a distinct tongue, evolving alongside the people who spoke it, and for the development of written Hebrew, first appearing in inscriptions centuries later and eventually codified in the biblical texts.

But an important question to ask is why would a largely indigenous people emphasize the memory of slavery in Egypt, if most of them had never been there? Scholars who challenge the literal Exodus suggest that the story serves a symbolic and identity-forming function. Memories of oppression or servitude — perhaps experienced by a small group or transmitted from earlier generations — were amplified into a national narrative, creating a shared story of suffering, Divine

deliverance, and moral identity. While slavery is normally considered shameful, the biblical narrative reframes it as formative and redemptive, making it a source of pride rather than disgrace. This narrative construction, according to its advocates, helps explain why the Israelites retained such a story so prominently: it established social cohesion, theological purpose, and collective memory, even if the literal historical scale is debated.

Another important question to ask is why a largely indigenous people would emphasize the memory of conquest of Canaan if it was already their ancestral homeland. Modern critical scholarship offers several explanations for this phenomenon: the conquest narrative may have served to legitimize Israel's possession of the land through Divine grant rather than mere residence; to unify diverse local populations under a common national origin story; to mark an ideological rupture with Canaanite culture; and to participate in the prestigious conquest traditions of the ancient Near East.

Some scholars maintain that the narrative preserves the memory of a smaller exodus group that later merged with indigenous highland populations, its story eventually becoming the shared national tradition of all Israel. For example, R. E. Friedman suggests that portions of the narrative may encode historical kernels of migration or elite escape episodes, rather than a single, large-scale exodus. Including these perspectives highlights that, while the mainstream archaeological-linguistic evidence points to a gradual emergence within Canaan, there remain uncertainties and differences of opinion, underscoring the complexity and richness of the early Israelite story without undermining the main scholarly consensus.

But who were the Canaanites, anyway? In the Torah, the "Canaanites" are not presented as a single homogeneous people but as a collection of related populations inhabiting the land of Canaan, roughly corresponding to the southern Levant. Different biblical passages give somewhat different lists of these peoples. Genesis 15:19–21 names ten groups: the Kenites, Kenizzites, Kadmonites, Hittites, Perizzites, Rephaim, Amorites, Canaanites, Girgashites, and Jebusites. Elsewhere, especially in passages such as Deuteronomy 7:1, the list is reduced to the more familiar seven nations: the Hittites, Girgashites, Amorites, Canaanites, Perizzites, Hivites, and Jebusites. These variations suggest that the biblical lists are not intended as precise ethnographic catalogues but rather as traditional designations for the various peoples understood to inhabit the land before Israel's settlement.

The term "Canaanite" itself functions both narrowly, for certain lowland populations, and broadly, as a general designation for the wider cultural world of the region. The Amorites were a major West Semitic population widely attested throughout the ancient Near East. The Perizzites are more obscure and may reflect

a rural or social designation rather than a clearly defined ethnic group. The Hivites and Girgashites remain poorly understood in historical terms, while the Jebusites are associated specifically with pre-Israelite Jerusalem.

The Hittites occupy a somewhat different position within this list. While the biblical narratives sometimes present them as one group among several local Canaanite populations, modern historical knowledge shows that the Hittites were in fact part of a major Bronze Age civilization centered in Anatolia, with a powerful empire based in Hattusa and significant influence extending into northern Syria. In that broader regional context, the presence of "Hittites" in Canaan is often understood not as evidence of a small obscure tribe, but as reflecting awareness of, or contact with, a much larger and politically significant people of the wider Near East. Whether this presence in southern Canaan represents small migrant groups, cultural memory, or simply a traditional ethnonym used in Israelite classification remains uncertain, but the term itself is historically associated with a major imperial power rather than a minor local clan.

The Philistines, although frequently mentioned in the patriarchal, Exodus, and later narratives, are not included among the Canaanite peoples in the biblical classification. This reflects their consistent portrayal as a distinct group, associated with a non-Levantine origin (often linked in scholarship to the wider "Sea Peoples" phenomenon). Unlike the Canaanite populations, the Philistines are depicted as newcomers to the southern coastal plain, organised in a network of city-states and initially culturally distinct, with their early linguistic profile generally thought to have included a non-Semitic element (inferred mainly from personal names and comparative evidence), before gradually assimilating into the surrounding Levantine West Semitic linguistic environment over time.

In the biblical narrative itself, the Canaanite peoples are still prominent during the conquest traditions (Joshua) and remain partially present throughout Judges. Over time, however, they cease to appear as a coherent set of identifiable "nations." By the monarchic period (Samuel–Kings), the lists of seven or ten Canaanite groups have largely disappeared as living political categories, surviving instead as occasional references, localized survivals, or theological and archaic designations rather than as a structured ethnographic framework. The Philistines, by contrast, remain a major political and military presence throughout the period of the Judges and early monarchy, but gradually lose independent status following the expansion of Assyrian and later Babylonian imperial control. By the late biblical period, they are no longer depicted as a distinct political force, and the term "Philistia" functions mainly as a geographical rather than ethnic designation.

In secular historical and archaeological perspective, the picture is one of transformation rather than abrupt disappearance. The "Canaanite" world corresponds broadly to the Late Bronze Age city-state culture of the southern Levant (c. 1550–1200 BCE), characterized by closely related Northwest Semitic languages, shared material culture, and overlapping religious traditions. Following the collapse of this Bronze Age system around 1200 BCE, population continuity is evident, but political and cultural identities reorganize into new formations. Highland groups that later become "Israelites," coastal city-states that develop into "Phoenicians," and inland polities such as Aram, Moab, and Edom all emerge from this transformed landscape. In this sense, "Canaanites" do not disappear abruptly but are gradually reconfigured into successor cultures, with the Phoenicians representing the clearest cultural continuation of the Canaanite tradition.

Similarly, the Philistines are historically visible from roughly the 12th century BCE as part of the Iron Age I settlement horizon in the southern coastal plain. Over the following centuries, they undergo progressive cultural assimilation under Assyrian and Babylonian imperial dominance, and by the early first millennium BCE they cease to exist as a distinct ethnic-political entity, leaving only regional and archaeological traces of their earlier presence. In linguistic terms, this trajectory is mirrored by a shift from an initially distinct, non-Semitic substratum in the early phase to full adoption of local Canaanite-type (West Semitic) dialects in the later Iron Age, as reflected in inscriptions from Philistine urban centers.

Modern archaeology and historical linguistics generally regard these groups not as sharply distinct ethnic entities in the modern sense, but as components of the broader Canaanite cultural world of the Late Bronze Age, which shared closely related Northwest Semitic languages, overlapping material culture, and common religious traditions. The biblical lists are therefore usually understood as theological and traditional classifications rather than precise historical ethnography, though they may preserve echoes of a complex and regionally interconnected population landscape. Within this wider picture, the Philistines are typically treated as a distinct intrusive element in the southern coastal Levant rather than part of the Canaanite matrix, though they rapidly became embedded within it through processes of settlement and acculturation.

3. R. E. Friedman's idea

Richard Elliott Friedman, in *The Exodus*, develops a historical reconstruction of the Exodus narrative that occupies a middle position between traditional religious readings and minimalist skeptical approaches, arguing that the biblical story

reflects a real but much smaller historical event than the national-scale departure described in the text. He proposes that the Exodus was not the migration of an entire people but rather the experience of a smaller group — possibly associated with the Levites — who left Egypt and were later integrated into emerging Israelite society in Canaan, bringing with them traditions, including the worship of Yahweh, that became central to later Israelite religion. To support this, he points to the Egyptian origin of certain biblical names such as Moses and Aaron as evidence of genuine cultural contact with Egypt, and he highlights internal biblical distinctions that set the Levites apart from other tribes, which he interprets as a trace of a separate historical origin. From this perspective, the Exodus tradition preserves a transformed memory of an actual historical core that was later expanded into a national foundational narrative.

However, this reconstruction is contested: archaeologists generally find no direct material evidence for any migration from Egypt into Canaan, even on a limited scale, and suggest that Egyptian linguistic or cultural elements could equally reflect contact, borrowing, or literary shaping rather than migration; other scholars question whether a relatively small group could generate such a dominant national memory, and more broadly caution against treating biblical narratives as straightforward historical records rather than theological and literary compositions. Despite these objections, Friedman's account is widely regarded as a serious and disciplined attempt to correlate textual criticism with historical hypothesis, even if its specific reconstructions remain speculative within the broader scholarly debate on the origins of ancient Israel.

For my part, my main difficulty with Friedman's thesis on this subject is its lack of historical precision. While the proposal that a smaller group — identified with the Levites — came from Egypt is suggestive, it leaves crucial questions unresolved: who exactly were these people, and when and how did they arrive in Canaan? Did they enter as an organized group at a specific historical moment, or as scattered migrants over an extended period—and if so, over what timescale? If they arrived collectively, what prior history explains their cohesion as a group, and under precisely what circumstances were they accepted by the existing Israelite population (whether aboriginal or descended from earlier immigrants)? If, alternatively, they arrived individually or successively in small numbers, what bound them together into a distinct "tribe," the tribe of Levi, and exactly how did such dispersed and presumably marginal migrants come to acquire recognized status, religious functions and authority, tithes and offerings, land rights, among

their Israelite hosts?[81] More generally, the hypothesis seems to presuppose patterns of social acceptance and integration — whether peaceful or coercive — that are insufficiently specified and not clearly grounded in known historical analogies, leaving the reconstruction suggestive but underdetermined at key points.

For these reasons, I find Richard Elliott Friedman's reconstruction in *The Exodus* unpersuasive. I wrote my objections to him, and he kindly sent me a detailed reply, but I did not find his answers entirely convincing. I quote him verbatim:

> "Thank you for your question. As you can imagine, many people have asked about this. Now, there is no way to know how it happened since it occurred before the birth of prose writing of history (or prose writing of anything). So we have to deduce it from archaeology, historical analysis, genetics, poetic texts, linguistics, and references in neighboring lands. I used all of these in the analysis in The Exodus. What we know is that (1) the Levites were not included in the earliest reckoning of the tribes of Israel (Song of Deborah). (2) The name Levi does not reflect the name of a person or place (as opposed to the names of other tribes of Israel or Judah). (3) The name (better: term) Levi denotes an attached person or group. (4) The first two occurrences of the name Yahweh are in Egyptian texts referring to a community of shasu in the region of Midian. (5) The Levite texts (and only the Levite texts) then refer to the introduction of Yahweh to Israel and the identification of Yahweh with the Israelite God El. (6) The Levites are genetically distinct from the other Israelites; also, the Levites have no common genetic distinction even with each other, indicating again that they were not a clan or tribe. (7) It was the Levites texts that introduced several religious/cultural innovations that were Egyptian in origin. (8) You ask why the Israelites would not have just pushed them back by force of arms. As I indicated, we have at least five different texts from five different sources,

81 The Torah, it should be noted, provided for the support of the Levites — and, in part, the priests (a subset of the Levites) — through various dues from the Israelites. Thus, the Levites were assigned the tithe (*ma'aser*) of agricultural produce (one-tenth of grain, wine, and oil) as their main sustenance, in lieu of territorial inheritance (Numbers 18:21–24); they were also included in the consumption of the festival tithe and supported by the triennial tithe alongside the poor (Deuteronomy 12:17–19; 14:22–29). In addition, the priests received specific portions from the people, including heave-offerings and contributions (*terumah*), portions of various sacrifices, and firstfruits (Numbers 18:8–20; Deuteronomy 18:3–4), as well as the firstborn of animals (Num. 18:15–18). Alongside these provisions, the Levites were also assigned designated towns—the so-called Levitical cities—distributed among the tribal territories, together with their surrounding pasturelands (Numbers 35:1–8; Joshua 21), thereby providing them with places of residence despite their lack of a territorial allotment.

> prose and poetic, associating the early Levites with violence -- including violence against fellow Israelites (golden calf, Baal Poor). Force of arms was THEIR strength more than the residents'. What they then acquired was not "spiritual" leadership but rather MATERIAL leadership. Specifically, 10 percent of the produce of the country plus some cities, but no territory. It was a good deal for all the parties. I'd love to have any more items of evidence, but this already strikes me as enough to make this the most likely scenario. And I can't think of any other proposal by anybody that accounts for all of these elements from all of these different fields. I hope this helps clarify the case more efficiently than I put it in the book. With good wishes, Richard Elliott Friedman."

By contrast, my own suggestion *retains the basic framework of the Torah narrative while modifying its scale and duration*. The same principal actors remain: the twelve tribes and the Levites; likewise, the main narrative elements are preserved—a population descending from a few migrants originally from Canaan that sojourns in Egypt, multiplies, undergoes a period of servitude, attains collective liberation, and returns as a group to Canaan, where it eventually establishes itself, partly by force of arms, among the existing inhabitants. The difference lies chiefly in proportion: the numbers involved are drastically reduced (perhaps by a factor of a hundred, since most population figures given in the Torah account are round numbers), and the duration of the wilderness journey is correspondingly shortened to a matter of a few weeks, or at most a few months, rather than forty years. Within this compressed timeframe, key formative experiences — such as the reception of the Torah and other significant episodes — may still be retained, but understood as occurring in more rapid succession, without lengthy intervening periods. These adjustments are not arbitrary, but arise from practical considerations, since the large-scale, prolonged scenario described in the biblical account raises serious logistical difficulties concerning the provision of water, food, fuel, and fodder during such a journey, and since archaeological traces of such a journey have not, to date, been found. Clearly, the shorter the journey, the fewer the provisions required; and the smaller the number of travelers, the fewer traces they would be expected to leave.

8. RATIONAL THEOLOGY

1. About the soul

What do we mean when we refer to our "soul"? The *soul* is what we (human beings) experience subjectively as our deepest *self*, the core of our sense of selfhood, the essence of what makes each of us feel like a distinct, individual *person*. The self is a larger field of experience comprising each individual's *body* (the physical phenomena experienced as the soul's place of residence) and *mind* (the mental phenomena experienced besides the soul). Body and mind are thought of as belonging to the soul, as attached to it alone, but not part of it. The soul is immaterial and beyond mind. It is absurd, therefore, to look for it in passing mental or physical phenomena. The soul has a personality, it is a person; that is, it is not experienced as a mere thing, a dead bundle of natural phenomena, but as a distinctive, living entity. Another word for soul is spirit; hence, the adjective spiritual means pertaining to the soul, and spirituality refers to activity that nurtures or benefits the soul.

The soul is that within each of us which cognizes, wills, and values. Cognizing, willing, and valuing — or, more abstractly, *cognition, volition, and valuation* — are the three functions of the soul; that is, the three ways in which it expresses its individual existence and through which its individual character becomes manifest. Our experiences of cognition, volition, and valuation are unified by their common spiritual ground. It is very difficult to define these terms — soul, cognition, volition, and valuation — because they are so fundamental: they are not composed of more basic elements but are among the most distinctive aspects of existence. We know them through direct experience, by means of a faculty that may be called intuition or apperception. Such experiential knowledge precedes rational inference. When the soul is self-aware, it apprehends its cognitions, volitions, and valuations as its own, not as events external to it.

Cognition refers to the act of experiencing when we experience anything internally, within one's mind and body, or externally, beyond these. Cognition *does not* refer primarily to *the process* through which an object of consciousness is brought to the attention of the soul. No, the term refers primarily to that precise moment of consciousness through which we know something or of something, whether through intuition, sense-perception, conceptualization, memory-recall or imagination. *Consciousness*, or awareness, refers primarily to *the relation* between

a soul and an object, between a Subject of consciousness and an Object of consciousness. Note this well. Consciousness is always consciousness *of* something *by* someone. It is, to repeat, primarily a relational term. Subject and Object are philosophical terms referring to the two extremities of the line of relation (as it were) between the soul and whatever it happens to be aware of at a given moment. There is no such thing as consciousness without a Subject and/or without an Object. Consciousness has degrees; it may differ in intensity and/or in scope. Something known at a very low degree of consciousness is said to be known subconsciously. One is said to be *self-conscious* when one's cognitive faculty is turned on one's own soul to some degree, whether exclusively of any other object, as can happen in deep meditation, or vaguely in the background of wider acts of awareness, as happens routinely. A person is said to 'be conscious' or to 'have a state of consciousness' when and insofar as he or she is engaged in cognition to some degree; otherwise, he or she is simply unconscious.[82]

Volition refers to the act of will, which is distinguished from action in general by being relatively *free*; for this reason, to emphasize this aspect of it, we often refer to it as free will — but there is no will that is not free, an 'unfree will' is an oxymoron. Note that, to be precise, it is not the will that is free, the will is not an entity and has no will of its own; it is the soul itself that is free — to will as it wills. The freedom referred to here is freedom from causation, i.e. independence from deterministic causality to some extent. To say that we have freedom of the will does not, however, mean that we are entirely free of the causal determinism that purely physical and mental phenomena are generally subject to; our freedom is always circumscribed to some extent. We are also, in addition to having free will, insofar as we are bound to matter and mind, largely subject to causation. Moreover, even though some action, or decision preceding action, or choice of action, is free from causative forces, it remains ***influenced*** by things and events perceived or conceived by the soul.

This is very important to note and understand — the difference between influence and causation. Influence only occurs through consciousness of something, whereas causation occurs mechanically whether or not one is conscious of the cause.

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82 Buddhist use the term 'consciousness' as a noun, signifying an entity engaged in, or capable of, consciousness; but this is wrong usage, because it suggests that consciousness is a sort of cloud floating around over matter. This constitutes fallacious reification. The reason they do it is because they are dogmatically forbidden (nowadays, at least) to believe in a self or soul; so, they use the term consciousness (and often, similarly, the term mind) as a substitute, verbally concealing their (inevitable) effective reference to a self or soul. But consciousness is not itself conscious, only a soul can be conscious.

Influence is a form of causality, but it differs from the causation variety in that it operates through the intermediary of awareness of the cause. Whereas causation, when and where it occurs, overwhelms the soul's freedom of the will, influence never does that. Influence only makes a course of action, or decision or choice of action, *easier or harder* for the soul to some degree. When subject to a given influence, the soul must make more effort, or less effort, of will in order to pursue its goal. If, however, in the face of some object of consciousness, no amount of effort would enable the soul to will, or abstain from willing, a certain action, then that object cannot be said to exercise any influence at all on the soul at that moment. Thus, influence has degrees, but at the extreme degree of one hundred percent influence, pro or con, there is in fact no influence but instead the form of causality involved is that of causation. The people who fail to understand these subtleties are those who deny that we have freedom of will.

Regarding **valuation**, this term refers to the purposes of the soul's actions: its conscious or subconscious assessment of whether a given end is worth the effort of pursuing or avoiding. Valuation is thus also a causal factor, insofar as our volitions are influenced by the perceived value — or lack of value — that we attribute to the goals of our actions. Action would otherwise be blind and directionless; action devoid of purpose is capricious. Here, the biological significance of cognition, volition, and valuation becomes evident. Cognition without volition would be useless; volition without cognition would be blind; and cognition and volition without valuation would be erratic; any of these three scenarios would quickly result in the demise of the soul involved. These three faculties are therefore deeply intertwined and all necessary for survival. A living organism uses cognition to monitor its environment and volition to act within it — but the utility of both lies in their capacity to sustain life: to secure nourishment, avoid danger, and protect the organism from predators and other threats. Valuation is, at root, an assessment of the utility that something may have for the sustenance and defense of the organism's physical life. This concept is later broadened beyond the physical level, first to mental life and subsequently to spiritual life. Needless to say, such assessments can be correct or incorrect — that is, factually accurate or deluded. People can and do make erroneous valuations, pursuing goals that are useless or even harmful.

Many philosophers have denied the existence of the soul, claiming that our existence is, in fact, contrary to appearances, entirely material. They regard our mental experiences and spiritual impressions as illusory. They deny that we really have powers of consciousness, will and value-judgment. For them, all phenomena are essentially physical and exclusively subject to the natural laws governing

physical objects. The only forms of causality they recognize are physical causation and, at the subatomic level, natural spontaneity. They categorically reject causality through volition (and therefore also through influence). Since they deny the soul, they effectively deny its cognitive powers as well: what we call cognition is, for them, merely a complex network of physical events in the brain and the wider nervous system. Mental phenomena are, in their view, nothing but material phenomena. Likewise, what we call volition is reduced, in their view, to physical activity in the brain, typically resulting in muscular movements of the body. Ethics, which is based on value-judgment, is for them arbitrary. Likewise, logic, which is judgment of truth and falsehood based on the laws of thought, is for them arbitrary.

Such doctrines are problematic because they fail to account for the conditions under which they (the doctrines) are themselves formed. Their advocates do not explain how they acquire their dissenting opinions, or how they happen to choose to pursue such dissent. This is inconsistent, given that their doctrines effectively deny consciousness and free will, as well as the capacity to distinguish between good and bad, or between truth and falsehood. In this sense, they tend to underplay or completely disregard the significance of inner experience. Their methodology does not fully acknowledge all the data available to them; they turn a blind eye to much relevant information. Given these deficiencies, such doctrines are better described as materialist dogma than as valid scientific hypotheses. Can such views be challenged, and if so, how? A line of argument may be developed along the following lines.

When we internally experience mental images and sounds — whether apparently produced by sense-perception, recalled from memory, arising in dreams, or through emotional states, or occurring as voluntary verbal thoughts or imagined scenarios— we are confronted with mental phenomena. These are empirically evident experiences of an apparently non-physical kind, though they exhibit modalities similar to those of physical phenomena (such as color, shape, and sound). If our cognitions, volitions, and valuations were entirely physical events in the brain and the wider nervous system, there would seem to be *no need for* such phenomena to appear in any experiential form; they would be redundant and useless. Consider the following analogy. A computer receiving external or internal electronic signals has no need of a monitor or loudspeaker; it processes and integrates the information directly. A monitor or speaker serves a purpose *only if* there is someone outside the circuitry who needs to see or hear the output. It is only because the computer is designed to communicate with us that it requires a monitor or speakers in the first place.

Attempts to reduce cognition to impersonal processes leave out something crucial. Even if perception and thinking are described in mechanical or neurological terms, such descriptions still presuppose that these processes are experienced by a conscious individual. Things can exist without appearing, but they cannot appear without being experienced. There is no content of consciousness without a conscious subject. The enduring subject is what unifies the multiplicity of impressions over time and makes their understanding possible. The subject is continuously comparing and contrasting its impressions and judging how best to assimilate them and make them useful. The subject of experience cannot be eliminated without undermining the very concept of knowledge. If there is no underlying soul, it becomes unclear how beliefs can be held, revised, or justified over time. The soul is therefore not only what makes experience possible, but also what renders rational thought, judgment, and intellectual responsibility intelligible.

Furthermore, we must keep in mind that the idea of the soul as having volitions and valuations — that is, as engaged in willing in various ways, in pursuit of various values — is necessary to explain and justify the notions of agency and moral responsibility on which human society and law are based. Denying the validity of these concepts is therefore tantamount to rejecting the very basis of law and social order, effectively reducing human relations to a condition of anarchy or the law of the jungle.

2. About God

Before engaging is theological speculations, we should consider how we are able to, and do at all, *conceive* of God in a monotheistic perspective — at least today, after millennia of conceptual development.

Briefly put, we commonly view and understand God as a *spiritual* being, with an *omniscient* power of consciousness (i.e. of cognition), an *omnipotent* power of volition (i.e. of freewill), and having a perfect power of valuation (i.e. as *all-good*), by virtue of which He is both perfectly *just* and perfectly *merciful*. We attribute a pronoun to Him, to signify that He has a personality and is not some impersonal force of nature (an It) functioning under the compulsion of its fixed nature; and this pronoun is traditionally masculine (although no gender differentiation is intended in this special case).[83]

83 When I say "we," here, I of course do not mean that everyone thinks like me on the subject, for some people do not think about it at all and some think about it very differently. I am referring here primarily to people who have studied the matter sufficiently, i.e. informed intellectuals.

The basis for our belief in God is, first of all, epistemological, before any ontological speculations concerning Him can be attempted. The attributes we assign to God are not based on empirical observations of Him, since we have no direct perception of Him. How then do we know them or of them? They are hypotheses derived from our own very human experience of life, within us and all around us. *The intellectual process involved is one of analogy and extrapolation.* To be sure, not everyone consciously engages in such analogy and extrapolation; but the point made here is that when people think of God, they *can only understand* the term by means of analogy and extrapolation, be it consciously or subconsciously thought. This is important to note. It is hardly coincidental that many atheists also reject the existence of the soul, the irreducibility of consciousness, and genuine free will, subscribing instead to a materialist and deterministic view of the universe.

Thus, while the Torah affirms, "And God said: 'Let us make man in our image, after our likeness' … And God created man in His own image, in the image of God created He him; male and female created He them" (Genesis 1:26–27), the intellectual process reverses this order: human beings inevitably conceive of God in their own image and likeness. It is only by looking inward, into our own souls, that we can begin to apprehend the spirituality of God, and only by reflecting upon our own modes of thought and action that we can, through a process of idealization, conjecture as to His possible modes of thought and action. In Hebrew, the expression "in our image, after our likeness" is *betzalmenu kidmutenu*. This formulation is clearly intended metaphorically; any literal interpretation would be incompatible with Judaic monotheism. It is not evident why both terms are employed in verse 26, and why only the first is retained in verse 27. One might suggest, somewhat playfully, that "image" refers to the soul itself, while "likeness" refers to its functions. The use of the two terms may, however, simply reflect poetic variation rather than any intended conceptual distinction.

Just as we are essentially spiritual, i.e. are centered in a soul, though we have material bodies to which we are apparently bound for our mental and spiritual functioning, so is God spiritual, but more thoroughly spiritual than us since He has no bodily framework tying Him[84]. What is a soul? That which cognizes, wills, valuates — not some material or mental phenomenon. It is impossible to deny the soul without engaging in cognition, will, and valuation. Material and mental entities

84 This is at least true in the Jewish view, and apparently the Muslim one. Hindus and Christians, of course, believe that God may well incarnate. But, to my mind at least, this notion is unconscionable, mere fantasy.

do not have soul because they do not have these extraordinary powers[85]. Moreover, just as we cognize, will, and have values, in relation to the material world, so does God — so, there is some similarity between us in this respect too. Moreover, just as our soul is a self, i.e. is an individual person, so God is a self/person, and indeed He has the most pronounced and distinctive selfhood and personality of all.

Pushing further, just as we have cognitive powers, though limited ones, so has God cognitive powers, but His are without limits. There is much we cannot see, feel, or understand; but God's knowledge and wisdom are infinite, and even unbound by space or time. Again, just as we have volitional powers, being able to freely choose, though subject to internal and external influences and bound by our respective body and its material context, so God has volitional powers, but His are limitless. Our will is free to some extent, but not entirely free; God's will, on the other hand, cannot be moved or obstructed by any foreign forces. Moreover, just as we engage in value-judgments, and regard some things or courses of action as ethical and others as not so, though we do not always behave as we should, so God makes distinctions between good, bad, and indifferent, but additionally He differs from us in always freely choosing the good and eschewing the bad, so that He is ethically ideal in all His ways.

Note well, I am not here making existential claims: many people would contest this description of God's behavior (this is what theodicy is about). All I am saying is that this is our ideal *concept* of God, the starting point of our discussions concerning Him. It consists, as already said, of analogy and extrapolation. Just as we have a soul, with powers of consciousness, volition, and valuation, so (we imagine or propose) has God, only much more so, extremely so. If we did not do that, we would not be able to at all discuss the idea of God. An idea has to be formulated before it can be debated.

This is the idea of God as it has evolved to this day. It was not always so. In ancient Greece, for instance, the gods were a lot more comparable to ordinary men and women. There were many gods and each had limited powers of information, understanding, will, and morality; they were more powerful than humans, but not much more. In the evolved monotheistic perspective, God has similar powers to humans, but they are each taken to an extreme degree in every respect. It is, of course, very difficult, I'd say impossible, to definitively prove the existence and reality of such an all-knowing, all-powerful and perfect God. How could we do that? Even if He appeared to you in person and said hello, how would you be able

85 Buddhists, and many modern thinkers from David Hume onwards, do not believe we have a soul; but their position is not consistent.

to certainly infer the existence and reality of the said God from that simple experience? Belief in God *can only* be based of faith.

Furthermore, just as our souls cannot be precisely placed within or in the vicinity of our body, and yet are somehow closely tied to it, at least during its lifetime, so God has no specific location in the material world, though He is conceived as both within the world (immanent) and over and above it (transcendent), able at will to act within it or to withdraw from it. However, although we do not currently regard ourselves as creators of our body (although that is not metaphysically unthinkable), God is thought (by believers) to be the creator of all the world we collectively experience in the way of an explanation of that world. In truth, it is logically difficult to prove that proposition. Clearly, if we view the existence of the complex world before us as requiring an explanation, and propose God as the needed explanation, our curiosity cannot stop there. If the world is so complex, *how much more* complex would God have to be to create that complex world! Obviously, He has to be much more complex; and any explanation offered to explain Him in turn, would have to be even more complex, and so forth ad infinitum. So, this is not a logically unassailable argument.

Nevertheless, despite this logical difficulty, *it does not follow* that (1) God does not and never did exist, and that (a) the world itself was uncreated and eternal, or alternatively that (b) the world appeared spontaneously *ex nihilo* — because these ideas are very difficult if not impossible to swallow uncritically. In any case, it is *equally* conceivable that (2) God exists and that the world was in fact created by God and that God is himself uncreated, and yet either that (a) God was not eternal but came to be spontaneously *ex nihilo*, or that (b) He is eternal as believers believe.

Note that the notions of eternity and spontaneous occurrence *ex nihilo* are very logically similar in that they offer no convincing explanation of de facto existence. One or the other must be true, but both are equally difficult to grasp and believe. They both inevitably leave us a question mark. Philosophy will never solve these problems, I daresay — which is why, from the point of view of logical theology, all postures pro or con are inevitably faith-based. Ultimately, each person must decide for himself or herself what to believe or disbelieve, and bear the eventual consequences like it or not.

Regarding belief in God, I think the central issue is whether a person *wants* Him to exist or not. If one feels one needs God for one's peace of mind, and courage in the face of adversity, and hope of eventual justice and mercy, one believes more easily than if one does not feel any need for Him. This does not make belief fanciful or necessarily untrue, because God's existence cannot definitely be either proved or disproved by empirical or logical means. One's psychological openness or

receptiveness, or the lack of it, is a determining factor in this case. Everyone should ask himself or herself: do I *prefer* God to exist or not? Those who prefer it, opt for belief; those who don't, opt for disbelief.

Having said all that, honestly and frankly, I will now express my personal belief system. I do believe in God, out of faith. I have already stated how I view God — as a spiritual being known to lesser spiritual beings (like myself) through self-observation and self-analysis followed by analogical projection and extrapolation. Given that, it would seem to follow that we lesser souls have a tiny share in the spiritual identity of God — I like the Lurianic metaphor of us as sparks from the great spiritual light of God.

Once we infer the existence and attributes of God from ourselves, it becomes clear that we conversely have much in common with Him, even if in much diminished degrees. That is, while we epistemologically infer God from ourselves, it becomes clear that ontologically we are derived from Him. He is our Source, He who created us "in His image and likeness" (Genesis 1:26). The similitude referred to is clearly not material, but spiritual, since it is from our soul and its functions that we came to know of His greater soul and its greater functions. Hence the Lurianic metaphor.

However, we must be clear on various points. Spirituality is *not a substance*, merely different from the stuff of physical or mental objects (bodies, imaginations, etc.), it is something *entirely different*. Souls have no spatial extension or location. They are not bigger or smaller or here or there. Likewise, they have no other material attributes. With regard to time, it is not sure whether they are limited in time or timeless. We speak of them as if they have such spatial or other characteristics, but that is just because we have no language capable of describing them. We use the language of matter for spirit, but this is just imperfect analogy.

Thus, for instance, Isaac Luria's idea of *tzimtzum*, that the world was made possible by God contracting himself to make room for the material world He was about to create, calls upon *a spatial metaphor* that should not be taken too literally. It is a valuable idea, because it attempts to resolve the contradiction between our idea of God as ultimately the one and only existent, on the one hand — and the evident existence of a world of multiplicity, one that includes ourselves and all material things, on the other hand.

Similarly, the kabbalistic idea of a creation through unfolding of *sephirot* is given a visual representation by means of a series of spheres, each representing an aspect of God, gradually succeeding each other down from God until the world we face is reached — this too is a mere spatial metaphor which it is misleading to take too literally. The idea of sephirot can be a useful instrument of meditation, focusing on them (*kavana*) to get close to God (*devekut*) without having to view them as real.

To be sure, the reason this theory was developed was the felt need *to distance* God's holiness from His far less holy creation. But this has resulted in some very dubious notions. Notably, the distinction between God himself, as a transcendent, infinite, and unknowable being (the *Ein Sof*), and God divided up in spheres as the immanent creator and manager of the world. This idea has led some antisemites to heretically assert that the Jewish creator-God is a lesser god (or a non-god or worse, an anti-god) not to be confused with the true God labelled *Ein Sof*. To my mind, there is absolutely no logical basis for denying that God himself (i.e. as so-called *Ein Sof*) could have directly and immediately, without need for a divisive distancing process, have created and thereafter managed the world. The notion that intervening stages were necessary is pure fantasy, devoid of logical necessity.

Once this fantasy was accepted by kabbalists (it apparently started in the mid-13th Cent. in Southern France and Spain), they all found plentiful employment elaborating it in colorful (and to many people, inspiring) detail. Their main methodological error in doing so was *the fallacy of reification*. This consists in *thinking of abstracts as concretes*; for example, by naming the sephirot by means of the perceived *actions or qualities* of God (such as justice and mercy).

When we perform a virtuous (or, as the case may be, vicious) action, the characterization of that action as virtuous (or vicious) does not mean that such virtue (or vice) is *an entity* apart from us — it remains just a characterization of our action. Similarly, if someone repeatedly performs that action, he or she is said to have the quality of ongoing virtue (or vice), but that does not mean that ongoing virtue (or vice) resides in him or her as *a separable entity* — it remains simply a characterization of the oft-repeated action. There is no substantiality to such characterizations — they are abstracts, not concretes.

If I do good (or bad), it is not *because I am* good (or bad); rather, I am good (or bad) *because I do* good (or bad). The reason why this is true is that the former thesis is self-contradictory, whereas the latter is logically tenable. The concept of virtue (or of vice) depends on that of free will; if a person does something without free will, but because of what he constitutionally 'is', then that person has no credit (or debit) for his action and cannot be praised (or blamed) for it; he just acted mechanically, out of causation or natural spontaneity, forced to do so by his fixed nature, and so this action cannot be evaluated as virtue (or vice). If, on the contrary, he consistently yet freely acts in a certain way, he can rightly be called virtuous (or vicious).

For these reasons, it is inaccurate, indeed absurd, to describe God's actions in terms of sephirot. Essentially, what it amounts to is denial of *the absolute oneness of God*,

conceptually cutting Him up into little pieces. This is, logically, not true monotheism. It is contrary to the intent of the Shema which states: *Hashem echad*.

Yet the kabbalists on such flimsy basis engaged in endless speculations and richly detailed imaginations about God — claiming that these 'mysteries' are too high for man's intellect and at the same time indulging somehow in their revelation. They (wrongly) claimed to know what they (rightly) claimed to be unknowable, naïvely unaware of the self-contradiction involved in such simultaneous claims.

It apparently never occurs to gullible readers of fanciful mystical ideas to ask themselves how the speaker or writer could possibly know what he claims to know. Surely, it is not enough for a mystic to claim to have received a privileged direct communication from the prophet Elijah, or to have had prophetic visions of his own. Even claiming to have reached insights through natural meditation cannot be taken uncritically as truth. Such claims are simply impossible to prove. They could simply be based on wishful thinking, however sincerely believed in. Such criticism is not, however, applicable to rational discourse about God which acknowledges its hypothetical premises.

I submit that God's relationship to the world must be straightforward, without need for intermediaries or complications. Surely, He has *direct* awareness of whatever is going on and *direct* power over everything. I would tend towards advocacy of a *radical monotheism*, without literal prophetic imagery (such as of God sitting on a throne), without literal angels (and still less, demons), and without reified sephirot. The Tanakh and Talmud may well use such parables, but they should not be taken literally. They have a useful function, but theology cannot consistently be built on them.

Admitting that some narratives or doctrines of the written or oral Torah should be received as parables, as against literally, does not diminish the holiness of the Torah and subsequent developments of Judaism. Judaism is an educational and unifying force for Jews (and others), irrespective of whether the content is taken literally or otherwise. Our collective felt need for its teachings — in order to be and remain (good) Jews — is what makes the Torah holy.

3. About miracles

Anyone who believes in God and petitions Him through prayer thereby (*ipso facto*) affirms that God has the power to intervene in the world and, at times, does so.

Otherwise, such prayer would be pointless[86]. This intervention may be great or small, manifest or hidden, but faith assumes it to occur continually. In this sense, every believer in God affirms the reality of miracles. Most such 'routine' miracles, however, occur behind the scenes, as it were, and cannot be demonstrated scientifically. Accordingly, the term "miracle" may be understood in a broad sense as any action of God in our world, which may or may not transcend the laws of nature. In this broader sense, the very existence of the world is miraculous; the laws of nature are miraculous; our own existence is miraculous — indeed, everything is miraculous.

However, from a philosophical perspective, this should not be taken to imply that God is actively controlling everything that occurs in the world. Such a view is extreme: it renders the creation pointless, reducing the world to a system of constant micromanagement devoid of purpose. The opposite extreme is equally problematic: the conception of the world as a purely mechanical system, governed entirely by natural determinism and/or indeterminism, leaving no room for either Divine or human volition and purpose. A more reasonable position is that God possesses absolute volitional freedom and power to intervene at any time anywhere, yet refrains from doing so for His own reasons much of the time. The world is thus permitted to run, as it were, by 'inertia' except when God chooses to intervene in some way. This 'inertia' encompasses the operation of natural necessity, with apparently some natural spontaneity occurring at deeper levels, and the exercise of relatively limited but significant volitional freedom and power by humans and (to lesser degrees) by animals.

Regarding the miracles reported in the Torah, a lucid and critical approach is required. We must distinguish between events that are explicitly presented as miraculous and those later claimed, *ex post facto*, to be implicit in the text. In other words, we must carefully differentiate between what is read *out of* the Torah and what is read *into* it. What is textually evident — the plain meaning (*pshat*) — clearly possesses greater, or at least a different order of, value and credibility than interpretations subsequently proposed for it. This distinction is not always easy to draw, but in many cases it can be made with reasonable confidence. Ideally, the conclusion logically follows from the premises. However, often, an alleged interpretation appears somewhat forced: it seeks to impose upon the narrative a

86 It should be added that some people attribute miraculous powers to human figures they regard as saints, or to idols and similar objects of veneration. Such alleged phenomena may be distinguished, at least terminologically, from miracles performed by God by classifying them as "magic." Belief in miracles does not necessarily entail belief in magic.

detail, direction, or nuance that the text does not plainly support. In such instances, the proposed interpretation is less an added insight than a foregone conclusion that the text is used to rationalize.

At times, interpretations that are far from obvious are justified by appeal to the distinction between the Written and the Oral Torah. On this view, the received text is assumed to have been Divinely revealed and subsequently transmitted without corruption of any kind — despite some evidence to the contrary — and is therefore treated as intact and wholly reliable. Moreover, interpretations advanced by authoritative figures — prophets, Talmudic sages, and later rabbinic commentators — are held to derive from an oral tradition extending back to the original giving of the Torah, notwithstanding the lack of clear historical evidence for such a continuous transmission, even in later periods, and the apparent emergence of conflicting traditions over time.

Modern scholarship does not automatically accept these orthodox, faith-based assumptions, but subjects both the text and its traditional interpretations to critical examination. This methodological difference belongs to the field of hermeneutics. At its best, hermeneutics is free of prejudice and functions objectively and impartially.

Let us now review and classify some of the miracles encountered and analyzed in the course of the present study. The first and foremost is the miracle proposed in the opening chapter of Genesis: the explicit account of God creating the world and everything in it, including ourselves and our immediate environment. As we have shown, while this foundational notion of Divine creation is not in itself inconceivable, and indeed likely in the eyes of anyone who believes in God, the specific content, sequence, and timing of events described by the biblical narrator does not accord with modern scientific knowledge. Clearly, the narrator was unaware of very many of the findings of modern cosmology and biology, to name just these two sciences. Here we have an explicitly claimed miracle that is partly plausible, but partly contradicted by scientific knowledge.

The next alleged miracle, described explicitly and at length in Genesis 6–8, is that of a global flood. In this case, we have shown that such an event could not have occurred without so profoundly disrupting life on earth and its environment as to leave clear and enduring traces — traces that would still be evident today, yet plainly are not — if any human or animal life had survived. Moreover, human history did not come to a halt at the time in question, as the narrative implies; rather, societies, cultural monuments, and other forms of continuity proceeded unimpeded. In this case, we have an explicitly claimed miracle that is wholly implausible, being inconsistent with scientific and historical observation.

Genesis 8–11 recounts another set of alleged miracles associated with the Tower of Babel narrative — namely, the dispersal of humanity and the division of languages. As we have shown, the implied claims are in clear conflict with modern scientific accounts of human migration and linguistic development. Here again, we are confronted with explicitly stated miracles that possess no credibility whatsoever.

The narratives of the Israelites' exodus from Egypt and their subsequent wanderings in the wilderness of Sinai, recounted primarily in the books of Exodus and Numbers, contain numerous alleged explicit and implicit miracles. The miracle of population growth is explicit and, as we have shown, biologically conceivable under the right conditions. The account of the crossing of the sea is considerably more complex than it first appears, but remains, in the final analysis, conceivable — though only as a miracle, certainly not as an exceptional natural event. The provision of water in the desert is more problematic, including two explicit accounts of water miraculously gushing from rocks and a much later claim to a miraculous "well," with the principal difficulties being quantitative, logistical, and hydrogeological. While the narrator, and later interpreters, have attempted to support the narrative of desert wandering over four decades with various (rather weak) explanations concerning water supply, no account whatsoever is offered of how fuel was obtained for cooking or how fodder was secured to sustain livestock; these questions are not even asked. When these issues are eventually raised, apologetic responses tend to appeal vaguely to the notion that miracles were occurring so routinely that the narrator did not consider it necessary to mention them. We are thus confronted not only with explicit and implicit miracles, but also with what may be termed 'conjectural' miracles — that is, miracles posited presumptively to fill gaps in the narrative without ad hoc written or oral Torah support.

Thus, while belief in miracles is not in principle unreasonable, it does not follow that every alleged miracle — whether reported in the source text or later asserted by interpreters — is credible. Some are conceivable, whereas others are doubtful or implausible. In such cases, faith cannot serve as the sole and final standard of judgment. We can, through observation and calculation, and by drawing on scientific knowledge accumulated across various fields, form reasoned assessments; and if the verdict of such inquiry is negative, it ought to be accepted.

4. About religion

Religion is a many-faceted phenomenon. At its core lies a spiritual orientation, concerned with the soul and with questions of ultimate meaning. Yet religion also

exerts a wide-ranging influence on the psychological, social, cultural, political, and economic life of people, affecting both adherents and those outside any given tradition. There are several major religions, each comprising numerous subsets or derivatives (sects). Individuals may be born into them or enter them by conversion, and they may later leave or be excluded from them.

Religious communities generally have leaders, who may attain their position by heredity, by virtue of their spiritual attainment, learning, or personal following — or through appointment by an established religious hierarchy that effectively perpetuates its own membership and authority. In this respect, religions exhibit certain similarities to organized associations, in that they involve membership, norms, and boundaries, though they typically also lay claim to higher truth and significance.

The motives for remaining within or entering, or for exiting, a religion are varied. While spiritual considerations are often central, two additional factors of great importance are *identity* and *community*. Members of a religious group, whether large or small, identify with it, aligning their values and patterns of behavior — including not only ritual practices, but also other aspects of conduct such as personal physical and mental hygiene, social norms, and purely spiritual disciplines — at least in principle, so far as they can, with those of the group, and in return receive a sense of belonging within it.

The religion or sect, through the norms it establishes, thus actively shapes the identity of its members and thereby integrates them into a broader community. The members then participate in its various religious expressions, including prayer or meditation, learning and teaching, as well as, often, material support for its institutions and for those in need within the community. This is true of all religions and sects, even though the relative emphasis placed on these elements may differ.

In the case of Judaism, the fundamental precepts are belief in the existence of God, his uniqueness and unity, and in His being the sole creator and ongoing ruler of the whole world, the lawgiver and judge, and the universal provider and savior of His creatures, who is therefore to be feared and loved. For normative Judaism, throughout the history of its adherents, the Torah, the Jews, and Eretz Israel — meaning obedience to Torah law, love of fellows Jews, and attachment to the land Israel are central values.

On a practical level, Jewish tradition encompasses a wide range of positive and negative observances, varying in their degree of obligation or prohibition. In more recent times, however, as the societies in which Jews have lived have become more scientific and secular in outlook and more politically and socially emancipated, the Torah has come for many to appear — whether this is regarded as unfortunate or

fortunate depending on one's perspective — less credible and less binding. Consequently, whereas conformity was once more prevalent, contemporary Jewish life is marked by greater diversity in outlook and practice.

To my mind, those who have chosen to distance themselves from normative Judaism — whether out of greater knowledge or greater ignorance than the mainstream — have deprived themselves of many profound spiritual benefits. As the present detailed study of some of the principal Torah narratives has incontrovertibly shown, there are indeed good reasons to doubt that the Torah is wholly literally true. Yet this need not, in my opinion, lead one to abandon or reject it altogether. Most of its core beliefs, values, and virtues remain intact, as the cumulative products of millennia of Jewish history, collective wisdom, and beneficial practice. Observing the conduct of many Jews who have strayed far from traditional ways, whatever their motives, I do not find that they have gained much thereby. The soundest course, it seems to me, is one of moderation — eschewing both excessive religiosity and excessive secularism.

5. About the Torah

In traditional Judaism, the Torah is understood to be of Divine origin, revealed by God to Moses. According to this view, the central event in its transmission is the revelation at Mount Sinai, where Moses received both the Written Torah (the Five Books) and the Oral Torah, a complementary body of explanations and interpretations.

The Written Torah is held to have been communicated verbatim by God, with Moses acting as scribe. It is therefore regarded as perfect, unchanging, and authoritative in all its details. The Oral Torah, transmitted alongside it, was initially preserved through memorization and teaching, and later committed to writing in works such as the Mishnah and the Talmud. Together, these form a unified system of law, narrative, and guidance.

Traditional accounts maintain that this transmission was continuous and faithful across generations, safeguarded by a chain of teachers and scholars. Even where interpretation varies, the underlying text of the Torah is considered intact and identical to that given at Sinai.

Historically, this view does not see the Torah as a composite or evolving document, but as a single, coherent revelation. Any apparent repetitions, stylistic differences, or narrative tensions are explained through interpretive methods rather than attributed to multiple human authors. Thus, the Torah is seen not merely as an ancient text, but as a living covenant between God and Israel, binding across time.

Traditional Jewish authorities are aware that Torah manuscripts have been scattered across many lands — Yemen, Europe, North Africa, and elsewhere — and that minor variations have occasionally existed between them (usually involving spelling, defective/plene forms, or rare letter differences). However, they generally maintain that these differences are extremely small and do not affect the meaning or integrity of the text. The overall claim is that the Torah has been transmitted with remarkable fidelity.

The version that eventually became the standard text of Rabbinic Judaism is known as the Masoretic Text. This text was stabilized and meticulously preserved by a group of scholars known as the Masoretes (Heb. בעלי המסורה, *Ba'alei ha-Masorah*), who were active — remarkably late in the history of the biblical text — between the seventh and tenth centuries CE, especially in Tiberias. They developed precise systems of vocalization, cantillation marks, and marginal annotations designed to ensure the accurate transmission of the text.

Among the Masoretic manuscripts, one of the most authoritative is the Aleppo Codex, generally dated to around 930 CE. Produced in Tiberias and traditionally associated with the Masoretic scholar Aaron ben Asher, it is regarded in Jewish tradition as the most authoritative exemplar of the Masoretic Text, notwithstanding the loss of substantial portions in the twentieth century. Another important manuscript is the Leningrad Codex, dated precisely to 1008/1009 CE. As the oldest complete surviving manuscript of the Hebrew Bible, it serves as the base text for most modern printed editions.

Traditionalists typically argue that where small discrepancies between Torah scrolls exist, they can be resolved by reference to these authoritative traditions. In practice, Jewish law even addresses such issues: a Torah scroll with certain textual errors may be deemed invalid for liturgical use until corrected. This reflects the broader traditional conviction that, despite minor variations, there is a single, correct text—faithfully preserved and recoverable through the Masoretic tradition.

Modern academic scholarship approaches the Torah as a composite work that developed over time rather than as a single, unified revelation. Most scholars hold that the text reached its present form through a long process of composition, editing, and transmission spanning several centuries in the ancient Near East.

A classic framework for understanding this process is the Documentary Hypothesis, associated especially with Julius Wellhausen (1844–1918). a non-Jewish German scholar of religion and biblical studies. According to this model, formulated in the late 19th century, the Torah draws on several earlier written sources, commonly labeled **J** (Yahwist), **E** (Elohist), **D** (Deuteronomist), and **P** (Priestly). These sources are thought to reflect different periods, regions, and

theological emphases, and were gradually combined by later editors into a single narrative. Although this hypothesis in its classical form has been revised and criticized, many scholars still accept the basic idea of multiple underlying sources.

One contemporary scholar, Richard Elliott Friedman (b. 1946), in *Who Wrote the Bible?*, offers a more detailed and historically specific version of the Documentary Hypothesis by proposing likely identities or circles behind its main sources, treating the Torah as a compilation of earlier documents identifiable through recurring clusters of features—such as consistent use of different Divine names, distinctive vocabulary and style, and parallel or conflicting narratives—which, when grouped together, form coherent accounts with their own theological outlooks and historical settings (for example, northern, southern, or priestly contexts), leading him to portray the Torah not as anonymous tradition but as the work of a relatively small number of historically situated authors and editors whose identities can be partially recovered.

Friedman associates **J** (the Yahwist) with the southern kingdom of Judah, possibly an author connected to the royal court in the early monarchy (sometimes even suggesting a woman of the court). **E** (the Elohist) is linked to the northern kingdom of Israel. After the fall of Israel (722 BCE), Friedman argues, these two traditions were combined into a unified narrative (JE) by a redactor (RJE) seeking to preserve both. **D** (the Deuteronomist) is understood as developing in two successive editorial stages — a first Josianic composition (Dtr1), associated with the circle responsible for the religious reforms of King Josiah in the 7th century BCE and reflecting a reformist and optimistic outlook, and a later exilic revision (Dtr2), which reinterprets Israel's history in light of the destruction of Judah and emphasizes themes of failure and Divine judgment, with the Deuteronomist tradition sometimes further connected with figures such as the prophet Jeremiah or his scribal associates. **P** (the Priestly source), in Friedman's view, was composed by priests—whom he strikingly associates with the family of Aaron—during or after the Babylonian exile (586 BCE), emphasizing ritual, genealogy, and centralized worship. Finally, Friedman posits a redactor (R) who combined JE, D, and P into the Torah largely as we have it, preserving their distinct voices rather than harmonizing them completely. In one of his more distinctive suggestions, he identifies this redactor with Ezra, the post-exilic priest and scribe.

Friedman is best described as a skillful popularizer and synthesizer, with some interpretive boldness, rather than a foundational innovator. His work stands within an existing scholarly paradigm but presents it more clearly and confidently than many technical predecessors, which helps explain its wide influence. Yet although his conclusions remain significant, his approach represents only one strand in

contemporary scholarship, since while the general idea of a composite Torah is widely accepted, many modern scholars are more skeptical of sharply defined, continuous documents such as J and E, preferring instead models of smaller layers, supplementary growth, or more complex editorial development over time.

In addition to written sources, scholars emphasize the role of pre-literary oral traditions — that is, orally transmitted narratives, legal sayings, genealogies, and cultic traditions that were preserved and circulated within early Israelite society before being committed to writing. These may include, for example, ancestral stories about the patriarchs, foundational traditions about the Exodus and wilderness experience, and early legal customs later incorporated into covenant law collections. Narrative repetitions, stylistic differences, and variations in legal material are often taken as indications that such orally transmitted units were preserved independently over time and only later combined and edited into continuous literary works, contributing to the layered character of the final text.

Archaeology and comparative studies of ancient Near Eastern literature have also played a significant role in shaping modern scholarly approaches to the Torah, though the field is by no means uniform in its conclusions. Works such as *The Bible Unearthed* by Israel Finkelstein and Neil Asher Silberman argue that many of the Torah's narratives — particularly those relating to early national origins — reflect the ideological, political, and religious concerns of the kingdom of Judah in the 7th century BCE, with earlier traditions being reshaped and systematized in that later historical context. This approach is associated with a broader "low chronology" perspective in archaeology, which tends to date key developments in Israelite society later than traditional biblical readings might suggest, and it has generated substantial debate among scholars.

At the same time, it is important to note that these conclusions are not universally accepted within academic circles. Some archaeologists and biblical historians support earlier dates for certain cultural and political developments, while others maintain more cautious positions, emphasizing the limits of correlating archaeological evidence directly with specific biblical narratives. As a result, the scholarly landscape includes a range of views regarding the historical background of the biblical text. Nonetheless, a broad point of convergence remains: modern critical scholarship generally understands the Torah not as a verbatim record originating from a single moment of composition, but as the outcome of a long and complex historical process, in which diverse traditions were transmitted, reshaped, and combined by multiple authors and editors over time.

Modern academic Torah study is composed of several related approaches collectively known as "criticism," each focusing on a different aspect of how the

text of the Torah was formed, transmitted, and understood. The broad framework is higher criticism (or *historical* criticism), which examines the origins, authorship, sources, and development of the text over time, treating it not as a single composition from one moment but as the product of a long historical process of growth and editing. It asks how earlier traditions and documents may lie behind the final form, and how successive stages of composition shaped what we now read.

Within this wider field are several more specific "criticisms." *Textual* criticism (sometimes called lower criticism) works to reconstruct the most reliable wording of the text by comparing manuscript traditions, including the Masoretic Text and other ancient witnesses. Some examples of such variation are noted in Robert Alter's translation of the Torah. *Source* criticism investigates whether biblical books are built from earlier written sources, a question central to models such as the Documentary Hypothesis. *Form* criticism focuses on smaller literary units — stories, poems, or legal sayings — and explores their original social and religious settings, often connected to oral transmission. *Redaction* criticism studies how editors combined and shaped earlier materials into coherent works, highlighting theological and literary intentions in the process. *Tradition* history traces the long development of ideas and narratives before they were written down, while *literary* criticism in its modern sense treats the biblical text as a finished work, analyzing its structure, style, and themes without necessarily reconstructing earlier stages. Together, these approaches form the main tools of modern scholarly study of the Torah and its composition.

My work is best understood as a rational, scientific, and historical critique of selected Torah narratives, in which the biblical text is read largely at face value and some of its main claims about physical events and material reality are evaluated by means of logic, mathematics, and empirical evidence. It is therefore concerned primarily with the truth-status and plausibility of the narratives as statements about the world, rather than with questions of textual formation, authorship, or editorial development. It does not attempt to reconstruct the sources, composition history, or transmission stages of the Torah in the manner of higher criticism, nor does it focus on manuscript comparison, literary structure, or religious interpretation in ethical or theological terms. Instead, it stands outside the main branches of traditional biblical criticism by concentrating on the external testing of the text's literal claims using contemporary scientific and historical standards. It could be characterized as *factual* criticism, or more neutrally as factual assessment.

Nevertheless, this study has convinced me that there is much to learn from modern academic biblical research. It is not, as traditionalists sometimes claim, mere idle nitpicking motivated by hostility toward the Torah's message. On the contrary,

there are clear and substantial grounds for examining the text critically in various respects and for seeking well-founded answers to the questions it raises. Even the fact that the Torah is divided into five books rather than presented as a single continuous document is itself intriguing and invites closer scrutiny.

There have been brave attempts to reconcile traditional Judaism with modern biblical criticism and historical scholarship. A notable effort was that of Louis Jacobs (1920–2006). Jacobs's approach to the interaction between classical Judaism and modern biblical scholarship is expounded in several key works, including *We Have Reason to Believe* (1957) and *A Jewish Theology* (1973). More will be said on his ideas in the next chapter.

Historically, the Torah was the source of pure monotheism, and this remains one of its central teachings for both Jews and non-Jews. It should, however, be kept in mind that monotheism was the final flowering of a long and gradual spiritual development in the Middle East, first in Mesopotamia and then in Egypt. Throughout history and across cultures, human beings have struggled, with varying degrees of success, towards spiritual growth, seeking to understand the world and their place within it. In modern times, philosophers have sought to ground monotheism in reason alone, without recourse to revealed texts. This is, to a considerable extent, possible — especially when addressed to a philosophically mature audience — but it is not necessarily the most effective means of disseminating monotheism widely.

The Torah is a vast and multi-layered text in which narrative (haggadic) and legal (halakhic) elements are closely interwoven. In traditional Jewish understanding, this combination makes the Torah not only a record of Israel's foundational history and laws, but also a vehicle for universal ethical instruction and spiritual orientation, expressed through concrete religious practice. A clear example is found in Numbers 15:39–40, a passage incorporated into the daily recitation of the Shema: "And it shall be unto you for a fringe; that ye may look upon it, and remember all the commandments of Hashem, and do them, and that ye go not about after your own heart and your own eyes, after which ye use to go astray; that ye may remember and do all My commandments, and be holy unto your God."

Here the ritual of the "fringes" (*tzitzit*) functions as a tangible reminder of the commandments, linking physical observance to moral awareness. At the same time, the warning against following "heart and eyes" is commonly understood in traditional commentary as addressing the inner sources of moral failure — mental desires and impulses, and the stimuli of sense perception — which can subtly draw a person toward wrongdoing, thereby offering a form of psychological insight into the dynamics of human temptation. Finally, the call to "be holy" expresses the

broader spiritual aim of the commandments, framing obedience not merely as rule-following but as a path toward sanctification. In this way, a single passage integrates ritual practice, ethical discipline, and spiritual aspiration within a unified religious vision.

As far as I can tell, my critique of various narratives in the Torah has no halachic (Jewish law) consequences; this work relates to certain haggadic (storytelling) passages. The stories concerned are largely homiletic in character; their aim is to exhort readers toward moral, spiritual, or religious improvement, and their significance is not fundamentally diminished if they are not taken literally. Indeed, fiction can sometimes inspire and motivate more effectively than fact, as Midrashic stories show. Acknowledging the fictional character of a narrative does not render it worthless; on the contrary, it may enhance the force and credibility of its message by removing distracting doubts concerning its historicity.

This is not something new or revolutionary. There are many expressions in the Torah and the broader Nevi'im and Ketuvim that are traditionally understood in a non-literal or metaphorical sense. A classic example is the description of God as having human bodily features, such as "the hand of God" or "the eyes of the Lord," which traditional commentators generally interpret as figurative language referring to Divine action or knowledge rather than physical form. Another well-known example appears in the Psalms, such as "The Lord is my shepherd" (Psalm 23), where God is not understood literally as a shepherd but as one who guides, protects, and provides, using a pastoral image to express spiritual care and guidance. In each case, traditional interpretation recognizes the use of metaphor and poetic imagery as a means of conveying theological and experiential truths in accessible human language.

Therefore, the conclusions reached in the present work concerning the exactitude of certain Torah narratives — regarding the content, sequence, and dating of the creation of the world and of humankind, the account of a global flood, the origin and chronology of human geographic dispersion and linguistic diversification, and various elements of the exodus and wilderness-wandering narratives — are not, on this view, matters for alarm or distress. They do not necessarily undermine the religious or spiritual standing of the text, since these passages may well be read in ways that are not strictly literal. On such an understanding, it remains entirely coherent to affirm *"haTorah emet!"* ("the Torah is true"), *even if not every narrative detail is taken as literally or historically exact*.

9. ADDITIONAL PERSPECTIVES

1. Some science and history books

Anyone wishing to fairly assess the accuracy of the Torah's narratives concerning factual matters of **cosmology, biology, or human history** is duty-bound to acquaint themselves with modern books on these subjects. There is no need to undertake advanced academic studies or become a scientist or historian for this purpose; books written for the general public are sufficient. Religious Jews, full of faith, are often taught — and consequently come to believe — that the Torah contains all that one needs to know about the world, and that its contents must therefore be literally true. But this remains wishful thinking so long as it is not tested by getting sincerely and honestly informed.

Over the years, I have read many books on general science and world history, and have greatly enjoyed doing so. Since my youth, self-education in these fields has been one of my principal hobbies, and has brought me much personal satisfaction. The following are among the books I read in the months before writing the present work, which I can recommend to readers who wish to deepen their knowledge of these subjects. It is worth reading more than one author on each subject, as each differs in perspective and the details chosen for emphasis.

Robert M. Hazen – *The Story of Earth: The First 4.5 Billion Years, from Stardust to Living Planet.* A lucid and engaging account of Earth's 4.5-billion-year history, tracing the planet's development from its cosmic origins to the emergence of life and the modern biosphere. Hazen combines geology, chemistry, and biology to present a compelling narrative of planetary evolution.

Andrew H. Knoll – *A Brief History of Earth: Four Billion Years in Eight Chapters.* A clear and authoritative overview of Earth's long history by a distinguished paleontologist, organized around eight major turning points in the planet's development. The book skillfully explains the geological and biological processes that shaped our world.

Tim Coulson – *The Universal History of Us: A 13.8 Billion-Year Tale from the Big Bang to You.* An ambitious and accessible synthesis linking the history of the universe, the Earth, life, and humanity into a single continuous narrative. Coulson seeks to show how the same underlying principles govern the development of everything from galaxies to human societies. It should be noted, however, that he

adopts a strongly materialist perspective, declining to recognize the human soul, consciousness, free will, and values as realities transcending the merely physical.

Andrew Marr – *A History of the World*. A lively and highly readable global history that combines broad historical coverage with vivid storytelling. Marr succeeds in making the great movements of world history accessible and engaging for the general reader.

J. M. Roberts (revised by Odd Arne Westad) – *The Penguin History of the World*. A sweeping and richly detailed survey of world history from prehistoric times to the modern era. Broad in scope yet highly readable, it provides invaluable historical perspective on the development of human civilizations across the globe.

Mendell Lewittes – *Principles and Development of Jewish Law*. A concise yet comprehensive introduction to the history, sources, and methodology of Jewish law (*halakhah*), tracing its development from the biblical period through the rabbinic era to modern times, written from a Modern Orthodox perspective.

Jewish history cannot be fully or properly understood without reference to world history. When focusing on the biblical era, one should study the histories of the peoples mentioned in the Torah narrative. For example, I found *The Civilization of Ancient Egypt* by Paul Johnson particularly interesting, as it offers a portrayal of ancient Egypt that differs significantly from that presented in the Torah and in traditional commentaries. Another example: *The Hittites* by O. R. Gurney, which made me realize that the Hittites mentioned in the Torah may have migrated to Canaan from the Hittite kingdom and later empire centered in Anatolia (c. 1650–1180 BCE).

2. Attempts to defend the Torah narrative

Many approaches are possible in dealing with apparent factual conflicts between biblical — and more broadly religious — narratives and the findings of modern science and history. One approach, which I have opted for in the present work, is to place primary weight on modern knowledge and to adjust the interpretation of religious texts as far as possible so as to minimize conflict, for example by avoiding literal readings where necessary. Another approach is to argue that the two sides are essentially in agreement; this is, as we shall see, the position adopted by Nathan Aviezer. A third approach is to seek maximal areas of compatibility, while nevertheless maintaining the religious narrative in cases of clear disagreement and largely setting aside the secular account without however actively challenging it; this is characteristic of the *Torah uMadda* perspective. A more radical approach is

to directly oppose the scientific or historical narrative itself, as in the case of Intelligent Design.

The common denominator of the last three approaches mentioned above is a strong presumption in favor of a literal reading of the biblical text. There have been many attempts, since the emergence of empirical science and modern historical inquiry, to defend literal readings of biblical narratives. The arguments advanced in such works must, of course, be given due attention and a fair hearing. Yet they often prove to be misinformed or somewhat fallacious in their reasoning, for their purpose is not to discover impartially what is objectively true, but rather to justify what is already assumed to be true.

Nathan Aviezer. Nathan Aviezer (formerly Wiser, b. 1935), a Swiss-born American Israeli physicist and longtime Professor of Physics at Bar-Ilan University, where he also served as Chairman of the Physics Department, has authored several books between 1990 and 2003 in which he sought, as an Orthodox Jewish writer, to reconcile mainstream scientific accounts of nature with readings of the Torah which, while not strictly literal, preserve a broadly traditional theological framework.

His principal works on this subject are: *In the Beginning: Biblical Creation and Science*; *Fossils and Faith: Understanding Torah and Science*; *Modern Science and Ancient Faith*; and *Relativity and the Bible: Genesis, Einstein, and the Creation Story*. The first addresses modern cosmology and physics with the aim of showing their compatibility with the biblical account of creation when read non-literally. The second turns to evolutionary biology and the fossil record, attempting to harmonize them with traditional Jewish belief. The third offers a broader survey of contemporary scientific theories in physics and biology, again arguing for their consistency with a non-literal reading of the Torah. The fourth presents the theory of relativity in accessible form and considers how, in his view, it may be reconciled with the Genesis creation narrative.

I have, to date, read only the first two of these works. In *In the Beginning*, Aviezer argues that the "days" of Genesis should be understood not as literal 24-hour periods but as extended epochs corresponding to stages in cosmic history. On this basis, he attempts to align the sequence of creation with modern cosmology, including the Big Bang, the formation of stars and planets, and the emergence of life. His method consists in placing biblical passages alongside scientific theories and proposing interpretive correspondences between them, which he claims dissolve apparent conflicts. In *Fossils and Faith*, he shifts focus to evolution, fossils, and the origin of life, broadly accepting evolutionary theory and the great

age of the universe, while arguing that these do not exclude a role for Divine purpose. In this context, he emphasizes the apparent improbability and fine-tuning of the conditions necessary for life and suggests that unresolved questions — especially concerning abiogenesis — leave conceptual space for theological interpretation, even as he explicitly rejects literalist creationism.

Across both works, Aviezer's overall strategy is to affirm compatibility between science and Judaism by reinterpreting scripture in non-literal yet non-skeptical terms, while also drawing attention to explanatory gaps or limits within current scientific theories that he sees as suggestive of design. Critics often respond that the correspondences he draws between Genesis and modern cosmology are sufficiently elastic to accommodate a wide range of scientific models, and in doing so risk reading contemporary conceptual frameworks back into ancient texts rather than deriving meaning from them; that appeals to improbability do not, in themselves, warrant inferences to design, since low-probability outcomes are to be expected over vast spatial and temporal scales; and that arguments based on current gaps in scientific explanation may be methodologically unstable as scientific knowledge advances. His work is therefore generally regarded as most persuasive when defending the non-contradiction of science and biblical faith, and less so when it advances positive theological conclusions drawn from scientific uncertainty, with its main significance lying in its rejection of both strict literalism and anti-scientific religious readings.

For my part, after completing the present work, I perceive a number of factual and interpretive weaknesses in Aviezer's analyses, which appear to reflect a desire — understandable in the context of his religious commitments — to confirm the Torah narrative, but which fall short of the level of rigor one might expect from a physicist of his standing. While there is no reason to question his intelligence or intellectual honesty, his hermeneutical methods are often insufficiently disciplined. I shall not attempt a detailed, point-by-point critique, which would likely require a study of considerable length, but will instead offer a few illustrative examples drawn from *In the Beginning*.

For instance, in his discussion of the first day (pp. 5–18), Aviezer quotes prominent scientists in a manner that can give the impression that they endorse the idea of Divine creation, when in fact their use of terms such as "creation" typically refers to an initial emergence without known, or even knowable, causation, the term being understood in a descriptive or methodological sense rather than as implying a theological cause. He then proposes, on the basis of Genesis 1:1, that God is the cause of what he calls the "primeval fireball," referring to that which explodes in the Big Bang, presenting this as a natural explanatory move. However, while such

a theological interpretation is certainly possible[87], it is not uniquely implied by the scientific model, which remains silent on ultimate causation and admits of multiple speculative extensions; for example, unending cycles of Big Bang and Big Crunch, or again the possibility that the Big Bang of our observable universe is a common occurrence throughout a much larger and older universe (a 'multiverse') inaccessible to our observation.

Aviezer then focuses on verse 3, blithely ignoring that it is preceded by verse 2, and claims that the creation of light there announced signifies the creation of the primeval fireball. He writes:

> "Cosmology has now established that the sudden unexplained appearance of the primeval fireball is the creation of the universe. The biblical passage 'Let there be light' may therefore be understood as designating the creation of the primeval fireball—the big bang—that signals the creation of the universe. All the matter and energy that exists today throughout the universe results directly from this 'light'. Note in particular that there were not two separate, unconnected creations on the first day—the universe and the light—but only one."

Aviezer's reading relies on reifying the early universe into a quasi-object (a "primeval fireball"), effectively identifying the early radiation-dominated plasma — a quantum thermal field state — with "light," and thus treating the two as a single unified entity rather than as distinct physical descriptions ("not two … but only one"). This conflation is not in accord with the mainstream scientific narrative, which — while readily recognizing the limits of current theory — distinguishes between any putative initial singularity (as classically predicted by general relativity) and the subsequent hot, dense phase of the universe described as a relativistic thermal plasma dominated by radiation. Aviezer thus compresses several distinct stages identified in modern cosmology into a single interpretive category.

In contemporary physics, the universe is modeled, from very early times onward, as a hot, dense plasma described by quantum field theory — a quantum thermal field state — in which radiation and matter exist as coupled components rather than as distinct macroscopic regimes. Photons are present within this thermal state at extremely early times, long before recombination and already during particle-physics epochs such as the electroweak era (roughly 10^{-12}–10^{-11} s after the Big

87 Note that I am not denying Divine creation. My position is that creation could conceivably have occurred at that stage, at a much earlier stage, or not at all; there is no way for us to determine this, let alone prove it.

Bang). However, they are not meaningfully describable at any putative "time zero," since the classical singularity merely signals a breakdown of general relativity near Planckian scales ($t \lesssim 10^{-43}$ s), where a theory of quantum gravity would be needed. Aviezer's reading is therefore better understood as a metaphorical mapping rather than as a direct correspondence with the scientific account.

More plausibly, Aviezer interprets the "separation" of light from darkness (v. 4) as corresponding to the epoch of recombination, approximately 380,000 years after the Big Bang, when the universe became transparent to radiation, and photons first decoupled from matter and could propagate freely. But of course, this analogy, though suggestive, remains interpretive. There is no evidence that this is what the narrator had in mind when he so expressed himself.

Following all that, Aviezer returns to verse 2, focusing exclusively on the expression *tohu va-vohu*, which he arbitrarily identifies with the "chaos" thought to characterize the very early universe in Big Bang theory, even though *tohu va-vohu* occurs in the text before the creation of light (and therefore, if we judge by his own interpretation, before the Big Bang), and even though the expression is applied there specifically to the Earth (*ha-aretz*) rather than to the universe. Such an interpretation of *ha-aretz* is linguistically problematic for the Torah narrative (as I have argued in chapter 2.2), since the term consistently appears in its plain, local sense. Moreover, the concept of a universe in its vast, modern sense is arguably far beyond anything the ancient narrator could possibly imagine. Remember that it was only in the 20th century, following Edwin Hubble's telescopic observations in the 1920s, that scientists realized that the "spiral nebulae" were in fact separate galaxies lying far beyond our own Milky Way. Furthermore, Aviezer pays no attention to the "deep" and the "waters" mentioned in verse 2, as though one were free to pick and choose whatever elements of the text one wishes to take into account.

He does, it is true, later (pp. 21–23) mention the "upper waters," suggesting that they might be identified with the abundance of water in the form of ice found in many comets and on numerous planets and moons within our solar system. However, this explanation does not account for the statement that God hovered "over the face of" the waters, which seems to imply a continuous expanse of liquid water situated above the firmament rather than discrete icy bodies scattered throughout it. It is also very doubtful that anyone in the pre-modern world could have possessed any knowledge of the plentiful ice present in outer space. Although comets were observed with the naked eye and recorded in antiquity, their physical composition as icy bodies remained unknown. The idea that comets contain substantial quantities of ice began to emerge in the late 19th century, notably through the work of Giovanni Schiaparelli and others, but it was only given a clear

physical formulation in 1950 through Fred Lawrence Whipple's "dirty snowball" model, and only firmly established thereafter through spectroscopy and later space missions.

These examples suffice to illustrate a general pattern in Nathan Aviezer's method: he attempts to establish correspondences between biblical language and modern scientific concepts by means of selective and at times tendentious readings of *both* domains. While such correspondences can be rhetorically suggestive, they do not, in general, provide a rigorous basis for claiming substantive agreement between ancient Genesis narratives and contemporary scientific cosmology and biology.

Gerald Schroeder. Gerald Schroeder is an Israeli physicist and Orthodox Jewish writer who is best known for attempts to reconcile modern cosmology and evolutionary biology with a literal reading of the opening chapter of Genesis. His central idea is that, when the Torah is read from a relativistic perspective, the six "days" of creation correspond not to ordinary 24-hour periods but to vastly longer cosmological epochs, as measured in the early expansion of the universe. In this framework, apparent tensions between scientific chronology (such as the age of the universe, the sequence of cosmic and biological development, and the emergence of life) and the biblical narrative are resolved by adopting a time-scale transformation based on relativistic physics. Schroeder presents this approach as a way of preserving both the literal truth of Torah and the empirical findings of modern science, while maintaining a traditional belief in Divine creation and providence.

Having read only one of his books and that many years ago, I cannot comment on his work here with any precision. Critics of Gerald Schroeder generally argue that his attempt to harmonize Genesis with modern cosmology relies on a non-standard and scientifically unjustified use of relativity, since general relativity does not permit the kind of global, retrospective rescaling of cosmic time required to align the six days of creation with the age of the universe. They further contend that his approach amounts to a form of post hoc harmonization, in which scientific concepts are reinterpreted after the fact so as to fit a pre-existing biblical framework, rather than being derived through independent physical analysis. In addition, philosophers of science note that his model does not yield independently testable predictions and therefore does not function as a scientific theory in the usual sense, but rather as a theological or apologetic reinterpretation of established science.

Briefly comparing Schroeder with Aviezer, it may be said that while both authors aim to harmonize Torah and science, Aviezer adjusts biblical interpretation to

accord with mainstream scientific findings, whereas Schroeder seeks to reinterpret scientific timescales so as to preserve closer fidelity to the literal Genesis account.

Torah uMadda. The doctrine of *Torah uMadda* is a modern intellectual orientation within Orthodox Judaism, most closely associated with institutions such as Yeshiva University and, in a somewhat different form, Bar-Ilan University, which seeks to integrate traditional Torah study with engagement in secular knowledge ("*madda*") within a single religious life. Rooted partly in earlier currents such as German Neo-Orthodoxy and the scholarly ethos of Wissenschaft (see below), it holds that general human knowledge — whether in science, philosophy, or the humanities — is not inherently in conflict with Torah, since both ultimately derive from a unified Divine truth, and can therefore enrich one another when properly understood. This outlook encourages a dual commitment to rigorous learning in both domains, not as isolated pursuits but as mutually illuminating modes of understanding, even if in practice they often remain methodologically distinct.

Its most influential philosophical expression is found in the thought of Joseph B. Soloveitchik, who described distinct but complementary forms of cognition — halakhic and broadly scientific — coexisting within a unified religious personality, with halakhic consciousness retaining normative primacy, while a generation later Norman Lamm articulated a more systematic defense of their compatibility, harmony, and mutual value. At the same time, this approach is not without internal tension, seeking to balance ideals of intellectual integration with the practical realities of cognitive compartmentalization, and affirming both the autonomy of different modes of inquiry and the overarching unity of truth, while maintaining openness to secular learning within the firm bounds of halakhic authority. Distinct from both isolationist Orthodox positions, which tend to distrust secular studies, and non-Orthodox movements that relativize traditional law, the *Torah u-Madda* programme represents an effort to inhabit both the *beit midrash* and the modern university, while maintaining that they are ultimately oriented toward a single coherent reality.

Joseph B. Soloveitchik's *The Halakhic Mind* (written in English in 1944, but published only in 1986) is his most explicit attempt to articulate a philosophical account of Jewish religious cognition in relation to modern scientific thought. Drawing on neo-Kantian epistemology, he argues that both scientific inquiry and halakhic reasoning constitute autonomous and internally coherent cognitive frameworks, each governed by its own categories, methods, and criteria of validity. On this view, the apparent conflict between religion and science arises not from any necessary contradiction in content, but from a category error: the mistaken

application of the epistemic standards of one domain to the other. Science, in Soloveitchik's account, constructs an objective, empirical model of reality, whereas halakhah constitutes a normative-intellectual structure through which religious reality is constituted and interpreted. The halakhic mind is therefore not subordinate to scientific reason, nor required to conform to it, but operates within its own legitimate sphere of rationality. This framework underlies Soloveitchik's broader insistence on the autonomy of religious cognition while allowing for conceptual coexistence with scientific description. A related but distinct expression of his thought is found in *Halakhic Man* (written in Hebrew in 1944, and translated into English in 1983), a more phenomenological and literary portrayal of the ideal religious personality shaped by a distinct mode of apprehending reality labeled halakhic consciousness. *The Lonely Man of Faith* (1965) is a philosophical-theological essay in which Soloveitchik reflects on the inner spiritual tension experienced by the religious individual in the modern world.

Norman Lamm's *Torah Umadda: The Encounter of Religious Learning and Worldly Knowledge in the Jewish Tradition* is the most systematic statement of his Modern Orthodox intellectual programme. In it, he elaborates the ideal of *Torah u-Madda* ("Torah and worldly knowledge") as a positive synthesis in which engagement with secular learning, including the natural sciences and humanities, is not merely tolerated but integrated into a broader religious worldview. Lamm argues that this encounter need not entail theological compromise or relativism; rather, it can function as a dialectical relationship in which Torah retains normative primacy while benefiting from intellectual and cultural enrichment derived from general knowledge. He devotes considerable attention to the philosophical justification of this synthesis, addressing potential tensions between revelation and scientific rationality and proposing models of coexistence, complementarity, and hierarchy that preserve the integrity of halakhic commitment while legitimating participation in modern intellectual culture. His earlier *Faith and Doubt: Studies in Traditional Jewish Thought* (1971) and its expanded edition (2006) provide a series of theological essays on the role of doubt within religious life and the nature of faith under conditions of modern intellectual challenge.

From my point of view, such compartmentalization and methodological differentiation is, of course, unacceptable. Human knowledge, to be credible, must ultimately be unified and coherent. Joseph B. Soloveitchik's view that religious and secular modes of thought may legitimately appeal to different methodologies and yet both be true is clearly influenced by Kantian epistemology; however, such a position, as a general theory of truth, has little standing in logical philosophy. There cannot be "two truths" that contradict each other. Lamm evidently sought to

formulate a less relativistic version of the same basic framework. While I strongly approve of the encouragement of *Madda* (secular studies) alongside Torah (religious studies), and vice versa, and fully recognize that there are matters within Torah that do not fall within the scope of *Madda*, and vice versa, it is nevertheless clear to me that wherever these two domains *intersect* — as they inevitably do whenever concrete claims are made about nature or humanity — the choice between them must be governed, without arbitrary compromise, by impartial scientific methodology, which means by means of both empiricism and rationalism, i.e. both inductive and deductive logic. There can be no allowance for blind prejudice in either direction.

Intelligent Design. Intelligent Design (ID) is a contemporary set of arguments in philosophy of religion and science which maintains that certain features of life and the universe are best explained by an intelligent cause rather than by undirected natural processes such as evolution, though it is not a unified scientific theory and is widely rejected as such within mainstream science. Its most prominent formulations include Michael Behe's "irreducible complexity," which claims that some biological systems (often illustrated by the bacterial flagellum or aspects of the immune system) could not function if any part were removed and therefore could not plausibly arise through gradual evolutionary change; William Dembski's "specified complexity," which argues that when something is both highly complex and conforms to an independent pattern (as in the informational structure of DNA), intelligence is the most reasonable explanation; and broader "fine-tuning" arguments in physics, which point to the apparently narrow range of physical constants compatible with life as suggestive of design rather than chance.

A further consideration often invoked in this context is the problem of the origin of life itself, sometimes expressed in terms of a "chicken-and-egg" dependency between nucleic acids and proteins. Since nucleic acids (DNA/RNA) are required for the production of proteins through the cellular machinery, while proteins are in turn required for the replication and processing of nucleic acids, it is argued that neither system could have arisen independently in a stepwise manner. From this perspective, the emergence of a self-sustaining system capable of both storing and expressing biological information appears to require a coordinated origin of multiple interdependent components, which ID proponents take to be difficult to explain through unguided chemical evolution alone.

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Supporters of Intelligent Design often reinforce these claims by analogy with everyday inferences to design (such as inferring a watchmaker from a watch or a coder from a message), and by arguing that standard Darwinian mechanisms of mutation and natural selection are insufficient to account for major transitions in biological complexity or for the origin of biologically functional information. Critics, however, argue that ID lacks the features of a scientific theory, particularly clear testability and falsifiability, and that proposed examples of irreducible complexity can often be explained by evolutionary pathways involving stepwise modification and the repurposing of existing structures. In response to the origin-of-life objection, mainstream research points to hypotheses such as the RNA world, in which RNA is proposed to have served both informational and catalytic roles, thereby reducing the need for an early protein–nucleic acid interdependence, though the plausibility and completeness of such scenarios remain debated.

Critics further contend that ID tends to function as a “god of the gaps” argument, treating current explanatory limitations in science as evidence of design, while such gaps may later be filled by further research. They also dispute both the informational and fine-tuning arguments by pointing to natural mechanisms for the generation of biological information and to alternative cosmological explanations such as multiverse or anthropic selection. As a result, Intelligent Design is generally regarded as a philosophical or theological position rather than a scientific research programme, with its most defensible form framed as an inference to design as the best explanation, but its most controversial form relying on contestable interpretations of scientific uncertainty. More fundamentally, the debate reflects differing assumptions about what counts as an acceptable explanation in science, whether undirected processes are sufficient in principle, or whether design must be admitted as a fundamental explanatory category.

Readers interested in further investigation of ID can consult the following books: **Michael J. Behe**, *Darwin's Black Box: The Biochemical Challenge to Evolution* — a foundational Intelligent Design work advancing the argument from "irreducible complexity" in biochemical systems; **William A. Dembski**, *Intelligent Design: The Bridge Between Science and Theology* — a systematic formulation of Intelligent Design theory, developing the concept of "specified complexity" and information-theoretic arguments against purely naturalistic explanations. **Richard Dawkins**'s *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design* is a classic and highly influential critique of design arguments, defending Darwinian evolution and natural selection as sufficient mechanisms for biological complexity; among others.

Intelligent Design has received a mixed and uneven reception across the major monotheistic traditions. Within Judaism, some Orthodox scientist-theologians emphasize general compatibility between modern science and Divine creation, sometimes employing design-like intuitions, but without adopting ID as a distinct scientific programme. In Christianity, ID has found its strongest and most organized support in certain evangelical Protestant circles, particularly in the United States, while most Catholic and mainline Protestant thinkers accept evolutionary theory within a theistic framework and do not regard ID as scientifically necessary. In Islam, attitudes are similarly varied but less institutionally focused on ID as such, with many scholars favoring general compatibility between evolution and divine causation rather than a formal design theory.

Not being an expert on biological issues, I cannot really comment either way. My position as a philosopher is that Darwinism, or any later development thereof, is not necessarily irreconcilable with belief in God and with the idea of Divine creation and governance of nature, since it is logically conceivable that God arranged the world in whatever way secular science, at any given stage, regards as most likely. There is no reason to doubt that God could have intentionally programmed evolutionary processes into nature. This stance is neither a denial nor an affirmation of Intelligent Design. I leave the matter to the relevant scientific experts to resolve among themselves.

3. Attempts to re-examine and modernize Judaism

Baruch Spinoza (1632–1677, Netherlands) is widely regarded as a pioneer of modern biblical criticism, being among the first to articulate a systematic historical-critical approach to the Bible. He was excommunicated (*herem*) from the Jewish

community of Amsterdam in 1656 for heterodox views concerning Scripture, God, and Jewish doctrine, including reported doubts about Mosaic authorship and the divine origin of the Torah.[88]

The **Haskalah**[89] was an 18th–19th century intellectual movement that sought to modernize Jewish life by drawing on European culture, Enlightenment rationalist philosophy, and evolving secular learning, in the context of the gradual emergence of Jewish political emancipation in Europe. Its early development is closely associated with **Moses Mendelssohn** (1729–1786, Germany), who argued for the compatibility of Judaism with reason and defended Jewish religious identity within an increasingly (albeit unevenly) tolerant civic society. Mendelssohn's most influential contribution in this context was his German translation of the Hebrew Bible, accompanied by the *Biur* (commentary), produced with associates, which aimed to make Scripture more accessible through its translation into the German vernacular and a novel, more rational and philological, commentary. Although he himself remained observant in traditional Jewish practice, he became a symbolic figure (in distinct ways) for later Jewish thinkers in Reform, Conservative Judaism, and Neo-Orthodoxy.

The Science of Judaism. *Wissenschaft des Judentums* (the Science of Judaism) was a 19th-century intellectual movement that arose in Germany with the aim of studying Judaism by means of the same historical, philological, and critical methods then being applied in modern universities to classical and Christian texts. Its proponents sought to establish Judaism as a subject of rigorous academic inquiry, demonstrating that it possessed a rich and evolving intellectual history, and situating its foundational writings — biblical, rabbinic, and philosophical — within their proper historical contexts. In doing so, they also hoped to counter prevailing anti-Jewish prejudice by showing the cultural and scholarly depth of the tradition, and, to some extent, to reconcile inherited belief with the emerging standards of modern scholarship.[90]

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[88] In his later philosophy, most fully developed in *Ethics* (1677), Spinoza identified God with Nature (*Deus sive Natura*), advancing a pantheistic view of reality that rejects a transcendent, personal conception of God.

[89] *Haskalah* derives from the Hebrew *sekhel* ("intellect"); its adherents were called *maskilim*, a term that was often used pejoratively by their traditionalist opponents.

[90] As regards the Documentary Hypothesis, which became a major subject of engagement and debate among Jewish scholars in the late 19th century, it did not originate with Wissenschaft

Key early figures in Wissenschaft des Judentums included **Nachman Krochmal** (1785-1840, Galicia/Austrian Empire), **Solomon Judah Rapoport** (1790-1867, Galicia/Austrian Empire → Bohemia/Austrian Empire), **Leopold Zunz** (1794–1886, Germany), **Eduard Gans** (1797–1839, Germany), **Abraham Geiger** (1810–1874, Germany), **Moritz Steinschneider** (1816, Moravia/Austrian Empire → Germany), and **Heinrich Graetz** (1817–1891, Germany). Krochmal is often viewed as an early precursor linked to the Haskalah, Rapoport and Zunz as foundational figures of the movement's early historical-critical phase, Gans as part of its broader Berlin intellectual milieu, Geiger as a leading representative of Reform-oriented scholarship, Steinschneider as a foundational bibliographer, and Graetz as its most influential historical synthesizer. Gans and Zunz were among the founders of the *Verein für Kultur und Wissenschaft der Juden* (Society for the Culture and Science of the Jews), established in 1819, which provided the initial institutional framework for the movement. Although differing in their religious outlooks, these scholars shared a commitment to applying historical, philological, and critical methods to Jewish sources, treating them as products of particular times and circumstances and thus as legitimate objects of academic inquiry.

Some participants in, or heirs to, this movement became leading advocates of **Reform Judaism**. Most prominent among them was Abraham Geiger, joined by figures such as **Samuel Holdheim** (1806–1860, Prussia/Germany) and **David Einhorn** (1809–1879, Germany → United States). They argued that Judaism had continually evolved throughout its history and should continue to do so in response to changing intellectual and social conditions. Accordingly, they regarded many traditional laws and customs as historically conditioned rather than permanently binding, and sought to reform Jewish worship and practice so as to preserve what they viewed as Judaism's enduring ethical and spiritual message while adapting it to modern life.

Others accepted the historical methods of Wissenschaft des Judentums without embracing the far-reaching religious reforms advocated by Geiger and his associates. The leading representative of this tendency was **Zacharias Frankel**

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des Judentums, although this school helped establish the broader historical-critical study of Jewish texts. Nor did the theory originate with Julius Wellhausen (1844–1918); rather, he developed and popularized its classical formulation in his *Prolegomena zur Geschichte Israels* (1883). Earlier stages of source criticism included Jean Astruc (1684–1766), who identified differing divine names and possible sources in Genesis; Johann Gottfried Eichhorn (1752–1827), who advanced critical study of the Pentateuch; and Wilhelm Martin Leberecht de Wette (1780–1849), who proposed important distinctions among biblical texts. Subsequent scholars further refined the multiple-source approach that Wellhausen eventually systematized into the familiar J-E-D-P framework.

(1801–1875, Bohemia/Austrian Empire). Frankel maintained that Judaism had indeed developed historically, but insisted that the halakhic tradition retained binding authority. Heinrich Graetz, although primarily remembered as a historian rather than a religious thinker, was closely associated with Frankel's position. This Positive-Historical approach later provided much of the intellectual foundation for **Conservative Judaism**, especially through the work of **Solomon Schechter** (1847–1915, Romania → United States), who emphasized the authority of the historical Jewish community in preserving and transmitting tradition.[91]

Zacharias Frankel's contribution to the historical understanding of Jewish law lies in his attempt to reconcile the binding force of halakhah with the fact of its historical development. For Frankel, halakhah is neither a static divine code nor a purely sociological product of communal practice, but a continuous juridical tradition shaped primarily through the activity of authoritative rabbinic interpretation. Legal change occurs through the accumulated weight of precedent, scholarly reasoning, and interpretive continuity within the rabbinic tradition itself. While Frankel acknowledges that custom and historical circumstance play a role in shaping the contours of law, the decisive mechanism of legal development remains the deliberative work of recognized rabbinic authorities operating within an inherited framework of textual and legal legitimacy.

Solomon Schechter, by contrast, shifts the center of gravity from rabbinic jurisprudence alone toward the lived historical reality of the Jewish people as a whole. In his conception of "Catholic Israel," normative authority is not located exclusively in formal legal reasoning but in the historically continuous practice and consciousness of the Jewish community. Rabbinic authority remains crucial, but it is understood as expressing and articulating a deeper underlying consensus embedded in communal life. At the same time, Schechter does not fully articulate the procedural mechanics by which dispersed popular practice becomes halakhically binding, or how tensions between rabbinic rulings and widespread usage are ultimately resolved. His account therefore suggests a broader and more communal basis for authority, but leaves the interaction between elite interpretation and popular religious life relatively under-theorized.

Later historical and sociological scholarship on halakhic development has tended to move beyond both models by emphasizing the multiplicity of forces involved in the formation of legal norms across different periods of Jewish history. In the

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[91] Schechter recognized the exceptional importance of the Cairo Geniza manuscripts for Jewish historical research and helped bring a large portion of them to the attention of modern scholarship, arranging their transfer to the Cambridge University Library.

biblical and early post-biblical periods, legal and religious authority is often associated with prophetic, priestly, and royal institutions, as in the prophetic critique articulated by figures such as Amos and Isaiah, the priestly establishment centered on the Temple (with figures such as Hilkiah as representative of priestly authority), and the decisive intervention of royal power in the reform of Josiah. Similarly, the work of Ezra reflects the post-exilic reconstruction and reconstitution of communal religious life around the textual authority of the Torah. In the rabbinic period, authority becomes increasingly centered in the interpretive and juridical activity of the sages of the Mishnah and Talmud, whose deliberations establish the framework for later halakhic discourse, and which is further developed and systematized in the Geonic period through responsa literature and institutional rulings. Across these shifting institutional settings, halakhic norms emerge not from a single mechanism but from a historically variable interaction between authoritative interpretation, institutional enforcement, and communal reception. In this perspective, neither purely top-down nor purely bottom-up models are sufficient; rather, the "mechanics" of legal development are understood as plural, contingent, and dependent on the changing structures of authority within each historical epoch.

The most influential Orthodox response to both Reform Judaism and the critical tendencies associated with Wissenschaft des Judentums was articulated by **Samson Raphael Hirsch** (1808–1888, Germany), founder of **Neo-Orthodoxy**. Hirsch accepted the value of secular learning and engagement with modern culture, but rejected any application of historical criticism that undermined the Divine origin and binding authority of the Torah. His program of *Torah im Derekh Eretz* sought to harmonize faithful observance of traditional Judaism with participation in the intellectual and civic life of modern society, thereby offering an alternative both to Reform innovation and to the historically relativistic tendencies within contemporary Jewish scholarship, later formative for Conservative Judaism.

I am not well-read in the literature of Wissenschaft des Judentums and therefore cannot at the present time comment in any detail on this school of thought. Until relatively recently, my intellectual orientation in religious matters lay closer to Orthodox (or perhaps more accurately, Neo-Orthodox) perspectives within Judaism, and I tended to view the Wissenschaft movement with some reservation, particularly because of its contribution to the emergence of Reform Judaism and its departure, in many respects, from traditional forms of Jewish observance.

More recently, however, as a result of reading more contemporary works, I have gained a greater appreciation of the intellectual coherence of the Conservative position and of the broader historical and theological complexities involved. It is

now clear to me that much of what I currently take for granted in Jewish studies — the historical, philological, and critical approach to Jewish texts — would not have been possible without the intellectual courage and pioneering work of the Wissenschaft scholars. I therefore consider myself, indirectly, one of their intellectual heirs, even though my own approach has developed along distinct lines.

Louis Jacobs. Rabbi Louis Jacobs (1920–2006) served as head of Jews' College in London, one of the principal Orthodox rabbinical seminaries in Britain, and was at one stage widely expected to become Chief Rabbi of the United Kingdom; however, his views on revelation led to his exclusion from mainstream Orthodox leadership, after which he went on to found the British Masorti movement (the UK equivalent of Conservative Judaism), which has continued after his death in both the UK and Israel, although its affiliated communities remain relatively small in both countries.

Jacobs' key idea is often described as "revelation through tradition." Rather than viewing the Torah as a verbatim, once-for-all Divine dictation, he argued that revelation is a dynamic, ongoing process in which the Divine is encountered and expressed through the historical experience of the Jewish people. The Torah, on this view, is not a directly dictated text but the record of Israel's response to God, shaped over time and preserved within the community's tradition. This allowed Jacobs to affirm both that the Torah is "from heaven" in a meaningful sense and that it bears the marks of human authorship, development, and historical context identified by modern scholarship. Revelation is thus not located in a single moment at Sinai alone, but in the continuous unfolding of religious insight within the tradition — including interpretation, law, and communal practice. In short, Jacobs reframed revelation from a static event into an ongoing interaction between God and the Jewish people, mediated through history and tradition. This approach aims to preserve religious commitment while honestly incorporating the findings of modern critical study. Some such approach seems to me necessary, even if it may be difficult to substantiate conclusively.

Louis Jacobs's books include: *We Have Reason to Believe* (1957) – An early and influential articulation of Jacobs's attempt to reconcile traditional Jewish belief with modern critical scholarship, particularly biblical criticism. He defends a form of faith that is intellectually honest, arguing that religious commitment need not depend on rejecting academic findings. *Principles of the Jewish Faith: An Analytical Study* (1964) – A systematic examination of classical Jewish doctrines, especially Maimonides' Thirteen Principles of Faith. Jacobs analyses their philosophical status and historical development, and questions whether they

function as binding dogma in Jewish tradition. *A Jewish Theology* (1973) – Jacobs's most sustained constructive theological work, presenting a modern Orthodox theology that integrates critical scholarship with religious commitment. He develops a non-fundamentalist approach to revelation, tradition, and Divine action. *The Book of Jewish Belief* (1984) – A more accessible synthesis of Jacobs's theological views, aimed at a broader readership. It summarizes key themes from his earlier work, including faith, revelation, and the compatibility of Judaism with modern thought. *A Tree of Life: Diversity, Flexibility, and Creativity in Jewish Law* (1984) – A major study of halakhah as a dynamic and evolving system. Jacobs argues that Jewish law has historically shown flexibility and creativity, challenging rigid or overly legalistic conceptions of halakhic authority. *The Jewish Religion: A Companion* (1995) – A reference-style work providing concise entries on concepts, practices, thinkers, and historical developments in Judaism. It reflects Jacobs's balanced engagement with both traditional sources and academic scholarship. *Beyond Reasonable Doubt?* (1999) – A late reflective work addressing questions of faith, doubt, and religious certainty. Jacobs revisits central themes of his thought, particularly the tension between critical scholarship and religious commitment, with a more personal and meditative tone.

Louis Jacobs' theological and methodological position is best understood as developing out of the nineteenth-century "Positive-Historical" school associated with Zacharias Frankel and later elaborated by Solomon Schechter. Frankel sought to reconcile the historical study of Judaism with the binding authority of halakhah, arguing that Jewish law had always developed historically within a framework of continuity and communal normativity. Schechter further shifted the emphasis from abstract legal theory to the lived historical experience of the Jewish people, formulating the idea of "Catholic Israel" as the locus of religious authority, in which the practices and consciousness of the historical community themselves carry normative weight. Together, these thinkers articulated a position that affirmed both critical historical awareness and the ongoing validity of tradition, while resisting the theological radicalization of Reform Judaism.

Jacobs' contribution lies less in the invention of new principles than in the systematic re-articulation of this Frankel–Schechter inheritance in the intellectual conditions of the mid- and late twentieth century. Writing in a context shaped by fully developed biblical criticism, modern philosophy of religion, and post-war denominational fragmentation, he reformulated the Positive-Historical approach in explicitly epistemological terms. In particular, he addressed the question of how a commitment to halakhic observance could be sustained without reliance on pre-critical assumptions about revelation or textual authority. In doing so, he translated

a largely nineteenth-century historical-theological stance into a more explicit and self-conscious framework of "non-fundamentalist traditionalism," thereby making it intelligible and defensible within contemporary academic and religious discourse.

A further, and more critical, implication of the view of Judaism as historically constituted through the gradual emergence and consolidation of tradition raises, in my view, a point that remains insufficiently clarified in the work of Frankel, Schechter, and Jacobs, whose formulations tend to remain at a relatively general level. They leave somewhat unclear the precise mechanisms by which historically contingent practices acquire normative authority. Jewish legal history appears to exhibit a complex interaction between communal usage and institutional authority. While popular observance undoubtedly contributes to the preservation and transmission of tradition, the emergence of binding norms has more often depended upon their articulation, interpretation, and ratification by recognized religious authorities. The balance between these top-down and bottom-up forces remains difficult to specify and is not fully theorized in the works under consideration.

The precise role of the individual practitioner in this process is left somewhat indeterminate. On the one hand, it seems reasonable to suggest that each act of observance contributes, in a small but real sense, to the reinforcement and continuity of inherited practice, while abstention or deviation may, at least in principle, weaken or modify its transmission. This would imply a degree of personal responsibility in the ongoing shaping of tradition. On the other hand, this cannot be the whole story. Historically, the transformation of widespread practice into binding norm has not been automatic, but has typically required recognition and authorization by religious authorities in the relevant historical context; popular usage alone has not generally sufficed to establish normative status without such institutional consolidation.

Effectively, Louis Jacobs addressed what is in many respects a task akin to squaring the circle: reconciling traditional Torah belief with modern scholarship, and succeeded in proposing a broadly persuasive resolution within that inherited framework. He is an exceptionally honest, well-informed, and intellectually rigorous thinker.

Robert Alter. Robert Alter (b. 1935) is an American literary scholar, critic, and translator best known for his influential work on the Hebrew Bible as a work of sophisticated literary art. A professor of Hebrew and Comparative Literature at the University of California, Berkeley, Alter has been widely credited with transforming modern biblical studies by foregrounding narrative technique,

stylistic nuance, and literary structure in the biblical text, rather than treating it primarily as a historical or source-critical document.

His most influential early statement of this approach is *The Art of Biblical Narrative* (1981), in which he argues that biblical prose employs deliberate literary conventions—such as type-scenes, repetition with variation, and subtle characterization—that have often been obscured by purely historical-critical readings. This work helped establish what is often called the "literary approach" to the Bible in modern scholarship and has been widely praised for restoring sensitivity to the text's artistry. Alter later extended this program in *The Art of Biblical Poetry* (1985), focusing on parallelism, diction, and structure in the poetic books.

His translation work, beginning with *Genesis: Translation and Commentary* (1996), represents the practical realization of this literary vision. In his "To the Reader" introduction, Alter sets out his aim of producing a translation that is as close as possible to the formal and rhetorical qualities of the Hebrew original, resisting both overly paraphrastic renderings and theological smoothing. He seeks to preserve the distinctiveness of biblical Hebrew syntax, its concreteness, its characteristic repetition, and its layered ambiguity, often at the expense of conventional English idiom, in order to allow readers to experience the text's literary force more directly. His introductory essays in his other biblical translation volumes are similarly interesting and consistently extend and refine these same methodological reflections.

Alter's work has been widely respected across academic biblical studies, literary criticism, and general readerships, and his translation of the Hebrew Bible (completed in stages beginning in the 2010s) has been praised for its stylistic sensitivity and fidelity to the source text's literary character. At the same time, it has also received criticism from some quarters. Traditional translators and some biblical scholars have objected that his strong commitment to literary equivalence can produce English that feels deliberately unidiomatic or austere, and that his rejection of certain theological or interpretive traditions may underplay aspects of reception history. Others in source-critical and historical-critical schools have also argued that his approach, while illuminating at the level of style, does not fully engage with questions of textual development and compositional history.

Nevertheless, Alter's work remains very influential, not least because it has reoriented attention toward the Hebrew Bible as literature, and has provided readers with a translation strategy that attempts to preserve, rather than domesticate, the strangeness and density of the original voice. For my part, I have learned much

from Alter's work and highly recommend it to anyone wishing to deepen their understanding of biblical texts as a literary creations.

Richard Elliott Friedman. Richard Elliott Friedman (b. 1946) is an American biblical scholar. He was Professor of Hebrew and Comparative Literature at the University of California, San Diego, for many years. His work combines mainstream documentary-critical methods with an unusually accessible, narrative-driven presentation of the formation of the Hebrew Bible, developed across several influential books.

In *Who Wrote the Bible?* (1987), he presents a popular account of the Documentary Hypothesis, arguing that the Torah is a composite of distinct sources (commonly labelled J, E, P, and D) that can be identified through consistent differences in Divine names, vocabulary, style, theological outlook, and narrative duplication, and that these sources were later woven together by editors who preserved much of their original continuity. In *Commentary on the Torah* (2001), Friedman offers a continuous scholarly translation and commentary on the entire Pentateuch, explicitly integrating his documentary reconstruction into the presentation of the text. The work is designed both as a readable modern translation and as a demonstration of how the J, E, P, and D sources interact within the received biblical text, often indicating source divisions and editorial seams directly in the commentary. In *The Bible with Sources Revealed* (2003), he goes further by laying out the reconstructed sources directly in parallel form, effectively presenting the reader with a "re-split" Bible that makes the hypothesized underlying documents visible as continuous texts in their own right.

In *The Disappearance of God: A Divine Mystery* (1995), Friedman explores the literary and theological development of Divine presence in the Hebrew Bible, arguing that earlier biblical texts portray a more immediate and anthropomorphic interaction between God and humans. and Israel in particular, while later layers — especially priestly and post-exilic materials — reflect a gradual "withdrawal" or increasing transcendence of the Divine. He interprets this shift not as theological decline but as part of the compositional and historical evolution of Israelite religion and its textual expression. In *The Hidden Book in the Bible* (1998), he extends the same approach to the narrative of the Deuteronomistic history, arguing that behind parts of Genesis through Kings lies a coherent underlying work — often associated with the figure of the J source — that can be read as a sustained literary composition once separated from later editorial layers. In *The Exodus* (2017), Friedman focuses in detail on the historical and literary background of the Exodus narrative, arguing — on the basis of textual analysis, Egyptian history, and archaeological

considerations — that the story reflects a memory of a smaller-scale historical event, likely involving a Levantine group with ties to Egypt, which was later expanded into the national founding narrative of Israel. He combines source-critical analysis with historical reconstruction, aiming to distinguish between the underlying historical kernel and the literary-theological shaping of the final text.

Across these works, Friedman's method remains consistent: he correlates linguistic patterns, theological emphases, and narrative tensions in order to reconstruct earlier written sources and the editorial processes that combined them, while also offering historically grounded suggestions about the social and political contexts in which these sources may have originated (such as differing northern and southern traditions or priestly and reformist circles). Although his reconstructions are widely discussed and have been influential in bringing source criticism to a broader audience, they are generally situated within an established scholarly framework rather than representing a new theoretical paradigm, and they are often seen as more confident and literary in presentation than many contemporary academic approaches, which tend to prefer more cautious models of layered textual growth and complex redaction over sharply defined continuous documents.

For my part, I have found R. E. Friedman's works highly instructive. For a long time, I hesitated to engage with the Documentary Hypothesis, fearing that it might undermine my faith. It was Robert Alter's mention of Friedman in one of his commentaries that gave me the impetus to explore this field. I was subsequently impressed by Friedman's detailed and rigorous presentations, and read all of his above-mentioned works with considerable interest. I do not necessarily agree with all his conclusions — particularly in his later work *The Exodus*[92] — but I find his overall approach highly stimulating. *Who Wrote the Bible?* and *The Bible with Sources Revealed* remain, in my view, his most accomplished contributions. As for his *Commentary on the Torah*, I regret that the exegetical commentary is at times relatively brief. In any case, I would strongly recommend Friedman's books to anyone interested in the formation of the Hebrew Bible.

Israel Finkelstein. Israel Finkelstein (b. 1949) is an Israeli archaeologist and one of the leading figures in contemporary biblical archaeology. He is Professor Emeritus at Tel Aviv University, where he directed the Sonia and Marco Nadler Institute of Archaeology. His work, often in collaboration with other scholars such as the journalist-historian Neil Asher Silberman, applies archaeological and

92 See my comments on this work in chapter 7.3.

historical methods to reassess the chronology and historicity of the biblical narratives, particularly those relating to the emergence of ancient Israel, the United Monarchy, and the early monarchy period.

In *The Bible Unearthed* (2001), Israel Finkelstein and Neil Asher Silberman argue that the historical narratives of the Hebrew Bible — from Genesis through Kings — should not be read as straightforward accounts of early Israelite history, but rather as texts that were largely composed, edited, and given their final ideological shape in the late Iron Age, especially in 7th-century BCE Judah during the reign of King Josiah. On their view, the biblical history reflects the theological and political concerns of that later period, not the distant events it purports to describe. They ground this thesis in archaeological evidence which, they argue, fails to support several major biblical claims: there is no material trace of a mass Exodus from Egypt, no evidence for a sudden military conquest of Canaan as depicted in Joshua, and no indication of a vast, unified empire under David and Solomon matching the grandeur described in the biblical text; instead, the material record suggests gradual cultural development within Canaan, continuity in settlement patterns, and the emergence of small, locally organized polities. Similarly, the wilderness traditions of extended Sinai wandering are seen as lacking archaeological correlates and are interpreted as later national memory shaped into a coherent foundational narrative. Within this reconstruction, early Israel is understood not as an external group entering the land, but as emerging gradually from within Canaanite society, with "Israelite" identity developing through slow processes of social and religious differentiation rather than sharp ethnic rupture. The biblical portrayal of a powerful united monarchy is therefore treated as an idealized or retrospective projection, reflecting later political aspirations more than historical reality.

A central element of the book is the proposal that the major shaping of biblical historiography occurred during Josiah's reign, when Deuteronomistic ideology — especially its emphasis on centralized worship in Jerusalem and covenantal obedience — provided the framework for interpreting Israel's past from Genesis to Kings. Methodologically, the authors combine archaeological data (including settlement patterns, stratigraphy, pottery analysis, and population estimates) with textual criticism to evaluate the plausibility of biblical narratives, treating the text as a historical source that must be assessed alongside, and often corrected by, material evidence. Their overall conclusion is that the Hebrew Bible is not a direct historical record but a sophisticated theological and ideological construction of late-monarchic Judah, whose primary significance lies not in literal reportage of early events but in revealing how Israelite identity and religious self-understanding were shaped in a later historical context.

Israel Finkelstein is closely associated with the "low chronology" approach, which proposes a later dating for key archaeological strata traditionally linked to the reigns of David and Solomon, and his broader approach situates the biblical text within the socio-political realities of the Iron Age Levant. His revisionist chronology, developed in collaboration with other scholars, has been influential in reshaping debates on early Israelite history, but it has also generated sustained criticism within Israeli and international archaeology.

Opponents—particularly those aligned with more traditional or "high chronology" frameworks—have argued that Finkelstein's reassessment compresses the timeline of the Iron Age too drastically and risks underestimating the scale and complexity of the early Israelite polities described in the biblical narrative. Scholars such as Amihai Mazar and others in the so-called "moderate" camp have contended that certain archaeological layers, which Finkelstein dates to a later period, are more plausibly associated with the United Monarchy, and that his revisions depend too heavily on reinterpretations of ceramic typology and radiocarbon calibration that are themselves open to methodological uncertainty. Critics have also suggested that his synthesis tends to prioritize minimalist readings of the biblical text, in which the historical value of the Deuteronomistic history is substantially reduced, thereby producing a reconstruction that some view as excessively skeptical.

Finkelstein's supporters, by contrast, argue that his approach better integrates archaeological data with broader regional patterns in the ancient Near East, but the debate remains a central fault line in contemporary Levantine archaeology, particularly in Israeli academic discourse on the historicity of early Israel. I have not yet read any of Israel Finkelstein's books, but I have seen a couple of television documentaries presenting his work, and was left somewhat unconvinced by what appeared to be a strongly revisionist stance toward the history of ancient Israel. As I am not an archaeologist, I cannot claim to offer an authoritative judgment either way. Nevertheless, I am inclined, on a provisional basis and as an outside observer, to regard Israel Finkelstein's narrative as comparatively more radical than those of his principal interlocutors, and thus to favor the more moderate interpretative position.

Daat Emet. Daat Emet (DE)[93] is an Israeli critical-rationalist organization that presents itself as offering a scientific, historical, and humanistic critique of rabbinic

93 The English-language homepage of Daat Emet, daatemet.org.il/en/, prominently features one Yaron Yadan, who presents himself there as "a former Haredi rabbi and now a critical scholar of religion." The organization's About page is at daatemet.org.il/en/who-we-are/about-daat-emet/,

Judaism and Orthodox interpretations of Jewish tradition, arguing that classical rabbinic literature — including the Bible and Talmud — should be understood as a historically conditioned human cultural system rather than as a direct or timeless expression of divine authority. Its central methodological stance combines historical-critical reading, philology, comparative ancient Near Eastern studies, and modern scientific reasoning, with the aim of exposing what it sees as anachronistic theological readings and scientific inaccuracies in traditional sources, and of re-situating halakhic and rabbinic development as an evolving legal and intellectual tradition shaped by its historical context rather than divine infallibility.

Alongside its textual critique, it advances a broader cultural and political programme that is strongly secular and Enlightenment-oriented, criticizing ultra-Orthodox social structures and religious influence in public life in Israel, and promoting a more rationalist civic culture. In style and orientation, it is explicitly polemical and interventionist rather than purely academic, positioning itself as a counter-educational voice engaged in public debate with religious orthodoxy, and can therefore be characterized as a secular-rationalist movement that challenges Orthodox claims to divine authority through a combination of historical criticism and scientific critique within an openly ideological framework.

I have read some of the content on their English-language website and found parts of it to be factually plausible and well-argued; however, I am personally put off by the site's aggressive anti-religious tone. It gives the impression of being driven by a secularist agenda rather than shaped by a strictly objective and impartial scholarly approach. I mention Daat Emet here merely to draw attention to it as a possibly interesting contemporary voice, not to endorse all of its views. Note that the most recent content I could find on this (English-language) website dates from 2006.

Adin Even-Israel Steinsaltz. Rabbi Adin Even-Israel Steinsaltz (1937–2020) was an Israeli rabbi, scholar, and teacher widely regarded as one of the most important modern popularisers of classical Jewish texts. Born in Jerusalem into a secular family, he later turned toward intensive Torah study and emerged as a prolific author and educator. His most influential achievement was the Steinsaltz Talmud, a pioneering edition of the Babylonian Talmud that adds vocalisation, translation, and continuous commentary, making the text far more accessible to readers without extensive traditional training. Beyond this, he wrote extensively on Jewish philosophy, mysticism, and biblical interpretation, and founded educational

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and a list of named "supporters" is provided on a separate page, daatemet.org.il/en/who-we-are/our-supporters/.

institutions aimed at broadening access to Jewish learning. He received major honours in Israel, including the Israel Prize, and remained an active writer and teacher until his death in Jerusalem in 2020.

The Steinsaltz Humash (2015) reflects this same overarching educational aim. It presents the Five Books of Moses with a modern English translation alongside a continuous explanatory commentary that integrates selected rabbinic interpretations, linguistic clarification, and conceptual explanation. Rather than offering a densely sourced classical commentary in the traditional style, it seeks to make the biblical text intelligible and coherent for contemporary readers, especially those without advanced background in Hebrew or traditional exegesis. The result is a readable, interpretive presentation of the Torah that prioritizes clarity and conceptual flow over exhaustive citation of earlier sources.

Critical reception of *The Steinsaltz Chumash* is mixed. Many readers and educators praise it for its clarity and accessibility, viewing it as an effective bridge to classical texts for modern audiences. At the same time, some traditional scholars criticize its selective use of rabbinic sources and its interpretive, synthesizing style, which they see as departing from more source-intensive classical commentaries. Others view this as an inevitable trade-off between making the text readable and preserving full scholarly depth.

The Artscroll Chumash tradition — most prominently represented by *The Stone Edition Chumash* (1993) and related volumes — adopts a markedly different interpretive stance. Its commentary consistently operates within a strongly confessional framework in which the authority of the classical rabbinic tradition is assumed to be fully intact and normatively decisive. Questions raised by modern historical consciousness or critical scholarship are generally not engaged as open problems, but are either excluded or resolved in favor of pre-modern exegetical positions, without acknowledgement of their contested status in contemporary academic discourse. In this respect, interpretive plurality is largely subordinated to the reaffirmation of inherited theological certainties.

The Steinsaltz commentary, while also firmly situated within an Orthodox commitment to the binding nature of the tradition, tends to be more explanatory and pedagogical in intent, often opening up linguistic, conceptual, and historical dimensions of the biblical text that are less foregrounded in the Artscroll approach. Nevertheless, this greater expansiveness remains bounded by a fundamentally traditional framework, and does not amount to a departure from classical assumptions regarding the authority and continuity of rabbinic interpretation.

For my part, I read Adin Steinsaltz's book with great interest and found in it some new insights and information absent from earlier orthodox commentaries.

However, while I greatly admire Steinsaltz's oeuvre, I found this work rather disappointing. A commentator unwilling to engage in genuine critical inquiry is liable to produce bland results. He does not ask difficult questions, let alone attempt to answer them; and he carefully avoids controversial subjects. He nowhere addresses the challenges posed by contemporary biblical scholarship, much less try to confront them in a serious and intellectually rigorous manner.

Although he occasionally alludes to modern scientific or historical findings — for example, that living organisms are composed of cells — this serves mainly to lend the commentary a superficial veneer of modernity, since he does so only where no tension arises with the orthodox narrative. Astonishingly, in a commentary on Genesis 1 written in the twenty-first century CE, he manages not even to mention the Big Bang of 13.8 billion years ago. A contemporary biblical commentary cannot afford to be so evasive and superficial; it must grapple directly with the central intellectual challenges of its age.

There is a large body of literature addressing the relationship between the Hebrew Bible — especially the Torah — and contemporary science and historical scholarship. The above-mentioned authors and works are merely some examples that I have personally encountered relatively recently. The present chapter is not intended as an exhaustive study of this literature, nor even as a comprehensive bibliography. My purpose has simply been to place my own work in the preceding chapters within a somewhat broader intellectual context. I shall therefore conclude the book here, thanking attentive readers for their kind attention.

10. CHAPTER SUMMARIES

The following are *AI generated*, rough summaries of the whole book and its main chapters.

Combined Summary of the Book: A Critical Examination of Torah Narratives

This book presents a rigorous and non-polemical critique of key Torah narratives, testing them against the findings of modern science, history, archaeology, genetics, and logical analysis. The author, while affirming belief in God and in Judaism's enduring spiritual value, argues that many biblical stories are factually implausible—or even impossible—when read as literal history, because they conflict with established empirical evidence. Yet these same narratives retain profound moral, ethical, and symbolic significance when understood as parables or didactic illustrations rather than as historical reportage.

The central methodological principle of the book is that science and empirical fact must take precedence in all matters concerning physical reality and historical chronology. Such an approach, the author contends, liberates faith from the need to defend untenable claims and makes possible a rational and intellectually mature Judaism. Assisted by AI research tools such as ChatGPT, Perplexity, and Gemini for investigation and calculations, the work charts a middle path: empirical scrutiny preserves the Torah's essential teachings without requiring belief in divine dictation of scientific or historical error.

1. On the Prologue

The prologue establishes the book's rational and non-polemical framework. Motivated by intellectual honesty rather than apologetics, the author seeks to expose factual errors in Torah narratives—such as the impossibility of a literal global Flood—without undermining Judaism itself or belief in God. Science and history are treated as authoritative in factual matters, while the Torah is understood as a repository of didactic parables conveying spiritual and ethical truths. The author explicitly rejects the traditional hierarchy implied by *Torah u-Madda*, in which religion ultimately overrides scientific conclusions, and instead advocates *Madaa ve-Torah*: science judges material questions, while Torah provides moral and spiritual guidance. Faith, in this framework, remains viable when interpreted

non-literally, while materialist philosophies are criticized for denying the reality of the soul.

An AI-generated overview summarizes the book's major conclusions: it critiques the Creation, Flood, and Babel narratives through cosmology, evolution, genetics, and linguistics; scales down Exodus logistics from two million participants to roughly twenty thousand; distinguishes between conceivable and impossible miracles; and advocates a radical monotheism stripped of kabbalistic reifications. The author also reflects on the historical evolution of writing—from handwriting and typewriters to personal computers, the internet, and now artificial intelligence. AI dramatically accelerates research and calculation, reducing tasks that once required hours to mere seconds, while remaining under the author's intellectual direction.

Biblical quotations are taken from the Jewish Publication Society translation via the Jewish Virtual Library, and the term "Bible" refers exclusively to the *Tanakh*. The prologue frames the entire work as constructive rather than destructive: Torah aggadah is treated as parabolic narrative with no effect on halakhah, while scientific truth liberates faith from literalism. It thus prepares the ground for the later critique of biblical physics and demography, as well as for the philosophical defense of soul and God.

2. On the World's Creation

This chapter compares Genesis 1 with modern cosmology and biology, exposing major discrepancies while affirming the chapter's enduring spiritual value. Science traces the universe from the Big Bang approximately 13.8 billion years ago through the formation of elementary particles, recombination at 380,000 years, the cosmic dark ages, the emergence of the first stars 100–200 million years later, the formation of the Sun and Earth at 4.6 and 4.54 billion years, the appearance of life around 3.5–3.8 billion years ago, the oxygenation event at 2.4 billion years, the rise of eukaryotes around 2 billion years ago, multicellular life 600–800 million years ago, the Cambrian explosion at 541 million years, major mass extinctions such as the Permian and Cretaceous events, and finally the appearance of *Homo sapiens* approximately 300,000 years ago. All of these unfolded through natural processes over immense spans of time.

A detailed verse-by-verse analysis of Genesis 1–2:3 examines the biblical creation narrative in light of contemporary cosmology, geology, and evolutionary biology, while insisting on a methodologically impartial reading of the text prior to any theological assumptions. The chapter argues that the narrative is fundamentally

earth-centered rather than cosmological in the modern scientific sense, reflecting the concrete conceptual world of its ancient author rather than an anticipation of contemporary astrophysics. It nevertheless acknowledges certain broad parallels with modern science, such as the idea of a gradual emergence of the world and the possible correspondence of some passages with early cosmic stages if interpreted metaphorically. At the same time, it emphasizes that many such harmonizations are linguistically strained, historically implausible, or dependent on reading modern scientific concepts back into the text ex post facto.

The analysis proceeds through each stage of the six "days" of creation, comparing the biblical order of events with current scientific understanding. It discusses the ambiguous status of Genesis 1:1 as either an introductory heading or an initial creative act; the meaning of *tohu va-vohu*; the creation of light before the Sun and stars; the conception of the firmament and upper and lower waters; the emergence of seas and dry land; the appearance of vegetation; and the creation of celestial bodies, animals, and humankind. The chapter repeatedly notes that the biblical sequence differs significantly from the scientific account in chronology, physical explanation, and biological development, particularly regarding stellar evolution, the age and formation of Earth, the history of plant and animal life, evolutionary processes, and extinction. It also criticizes attempts to evade these difficulties through selective reinterpretation or by ignoring the narrative sequence within individual "days."

At the same time, the discussion recognizes that some biblical motifs may loosely correspond to broad scientific realities when interpreted non-literally — for example, the gradual formation of structure in the universe, the long darkness preceding stars, the early oceanic state of Earth, or the precedence of marine life over terrestrial life. Yet the chapter concludes that these partial convergences do not amount to scientific foresight and are outweighed by numerous inaccuracies and conceptual limitations characteristic of an ancient earth-oriented cosmology. The final section reflects briefly on the meaning of the seventh "day," suggesting that, unlike the preceding stages, it lies largely outside the scope of empirical scientific evaluation.

The conclusion is that Genesis 1 is factually mistaken and therefore reflects human authorship rather than direct divine dictation. Yet it remains spiritually valuable by affirming God as creator and by conveying ethical ideals such as stewardship and restraint. Science is seen as compatible with theistic evolution—God creating through natural processes—and incompatible with young-earth chronology.

Traditional rabbinic dating derived from *Seder Olam*, placing creation in 3761 BCE, is shown to compress historical chronology, especially the Persian period,

and to conflict with archaeology. Genesis genealogies also imply biologically impossible lifespans, such as Adam's 930 years, which exceed known telomere limits of approximately 120 years. Other ancient chronologies, such as Archbishop Ussher's 4004 BCE, fare no better.

3. On the Age of Mankind

This chapter demonstrates that genetics, fossils, and demographic evidence decisively refute a literal Adam and Eve living 5,786 years ago, while preserving the Torah's symbolic message of human unity. Modern genetics places the origin of *Homo sapiens* in Africa roughly 300,000 years ago, emerging from large populations rather than a single couple. The vast diversity of human SNPs makes descent from two founders within only 231 generations mathematically impossible, and no genetic evidence exists for the severe bottleneck such a scenario would require.

Mitochondrial Eve and Y-chromosomal Adam are explained as lineage survivors within large populations, not as an original pair. Ancient cave art, such as the Sulawesi paintings dated to 67,800 years ago, further confirms humanity's deep antiquity. Rabbinic teachings about humanity's descent from one source, such as *Sanhedrin* 4:5, are interpreted symbolically and remain fully compatible with God-guided evolution.

The chapter traces humanity's evolutionary lineage through African *Homo heidelbergensis* or *Homo rhodesiensis*, supported by fossils such as Jebel Irhoud and Omo. Apologetic attempts to place Adam and Eve "among others" while preserving biblical chronology fail mathematically, since ordinary mutation rates could not generate observed diversity from two individuals in so short a time.

The chapter also discusses Y-chromosomal and mitochondrial inheritance, explaining why modern Jewish *Kohanim* and Levites display significant genetic diversity rather than uniform descent from Aaron or Levi. Population estimates further undermine literalism, showing millions of people already living during the periods traditionally assigned to Adam, the Flood, and Babel. Known bottlenecks, such as the Toba event or the Out-of-Africa migration, never reduced humanity to only two individuals.

4. On a Worldwide Flood

This chapter systematically demonstrates that Genesis 6–8 cannot describe a literal global Flood, though the narrative remains powerful as a moral parable against

corruption and vice. The biblical Flood spans 365 days: forty days of rain, 150 days at peak waters, and 175 days of recession.

The required water volume is impossible. Covering Mount Everest would require approximately 4.6 billion cubic kilometers of water—3.3 times all water currently on Earth. Even covering Mount Ararat would require 2.6 billion cubic kilometers. Flooding and drainage rates would exceed the Amazon River's discharge by enormous factors, and no credible source exists for such waters nor any destination for their removal.

The ark itself could theoretically float and support immense weight, and geometric accommodation of approximately 72,800 animals is not impossible. The real problem lies in biological logistics: a year-long voyage would require massive stores of feed and water, continual waste disposal, and constant care for tens of thousands of animals—far beyond what eight humans could manage. Traditional commentators such as Rashi and Ramban implicitly invoke miracles to resolve these difficulties.

Post-Flood ecological recovery presents additional impossibilities, including destroyed vegetation, saline contamination, and absence of prey. The drowning of tens of millions of people should have left unmistakable archaeological traces, yet none exist. Genetic evidence also excludes descent from Noah's family.

A catastrophe of this scale would have left geological evidence comparable to the clearly detectable Chicxulub impact. None exists. The rainbow predates Noah as an ordinary optical phenomenon, while parallels with the Epic of Gilgamesh suggest a regional flood memory transformed into universal legend. The chapter concludes that the Flood is historically impossible but remains morally valuable as a warning against vice.

5. On the Tower of Babel

This chapter critiques Genesis 8–11's account of post-Flood repopulation and linguistic fragmentation. The narrative requires the world to grow from eight survivors to over 100 million people in only 340 years, demanding annual growth rates far beyond historical possibility.

Genesis 10's seventy nations are shown to be schematic rather than historical, omitting entire continents and known earlier urban centers such as Jericho and Uruk. Ancient identifications proposed by Josephus and Rashi are incomplete and speculative. The likely inspiration is Babylon's great ziggurat Etemenanki.

Modern science places humanity's dispersal from Africa tens of thousands of years earlier, supported by fossils, genetic evidence, archaeology, and paleoenvironmental studies. Language likewise evolved gradually. The world's approximately 7,150 languages belong to identifiable families that diverged over millennia.

Hebrew is shown to be a relatively late Semitic language, deriving from Proto-Semitic through Phoenician-derived Paleo-Hebrew writing. Claims that Hebrew was humanity's primordial language are rejected. The notion of an instantaneous divine rewiring of human brains to produce separate languages is judged physically absurd.

The chapter concludes that Babel is legendary, perhaps preserving memory of a Mesopotamian ziggurat, while still expressing monotheism's critique of human arrogance.

6. On the Exodus and Wandering

This chapter analyzes the Exodus narrative's immense logistical challenges. The Torah describes seventy souls entering Egypt and growing into approximately 617,000 adult males—roughly two million total people—within 210 years. This would require impossible population growth under normal demographic conditions.

The crossing of the Gulf of Suez would require displacing approximately 3.7 billion cubic meters of water, demanding enormous energy and hurricane-level winds far beyond natural possibility. The event is conceivable only as a direct miracle.

Daily survival needs are equally daunting. Millions of liters of water, massive quantities of manna, quail, fodder, and firewood would have been required. The Torah does not explicitly describe miraculous provision of fuel or fodder.

The deaths of approximately 1.3 million adults over thirty-eight years should have produced massive cemeteries across Sinai. None have been found, nor do Egyptian records mention such an event.

The chapter concludes that a literal large-scale Exodus lacks historical support. Its moral message of divine deliverance remains powerful, but inductive reasoning favors legend unless future discoveries provide evidence.

7. On the Issue of Historicity

This chapter proposes a minimalist reconstruction of the Exodus. Dividing census numbers by one hundred yields an Exodus group of approximately 20,000 people rather than two million. Under this reconstruction, population growth becomes high but plausible, and the Sinai journey could have lasted only weeks rather than forty years.

This preserves the core historical narrative of slavery, liberation, Torah revelation, and conquest. The Jewish preservation of a humiliating slavery tradition rather than flattering national myths is taken as evidence for historical authenticity.

Archaeology shows that Israelites emerged in the highlands around 1200–1100 BCE as culturally Canaanite populations distinguished by pig avoidance and four-room houses. The *Merneptah* Stele confirms Israel's existence by 1208 BCE.

The chapter evaluates Richard Elliott Friedman's Levite migration theory but finds it too underdetermined. The author instead prefers a scaled-down version of the Torah's own account, balancing empirical evidence with traditional memory.

8. On Rational Theology

This chapter shifts from biblical criticism to philosophical theology. The soul is defined as the immaterial core of selfhood, characterized by cognition, volition, and valuation. These capacities are argued to transcend purely material explanation, and materialism is criticized as self-refuting.

God is conceived as infinite soul: omniscient in cognition, omnipotent in volition, and perfectly good in valuation. This conception is derived by analogical extrapolation from human self-awareness, effectively reversing the usual reading of Genesis 1:26–27.

Kabbalistic concepts such as *tzimtzum* and the *sephirot* are accepted only as metaphors rather than literal ontological entities, preserving radical monotheism. Prayer is interpreted as affirming divine intervention, whether through providence or extraordinary acts.

Miracles are classified according to plausibility. Creation itself and a limited sea-crossing are conceivable; a global Flood and literal Babel are not. The chapter insists on distinguishing *pshat* from later Midrashic elaboration, with empirical evidence overriding unsupported belief.

Judaism is affirmed as centered on God, Torah, and *Eretz Yisrael*, providing identity, continuity, and communal benefit. Both extreme secularism and extreme ultra-Orthodoxy are rejected in favor of moderation.

The chapter surveys traditional divine dictation theories alongside modern source criticism, archaeological scholarship, and Louis Jacobs' concept of revelation through tradition. The author applies literal testing only to aggadah, leaving halakhah untouched. Parables may be spiritually true without historical literalness.

The book concludes that Judaism's ethical and spiritual power is best preserved through minimalist history and rational theology: a real soul, a simple God, and a Torah liberated from literalism.

9. On Additional Perspectives

The final chapter broadens the perspective of the book by situating the Torah in relation to modern science, history, biblical interpretation, and contemporary critical scholarship. It encourages wide reading in the natural sciences and world history as an essential basis for evaluating biblical claims, while recognizing that different authors may illuminate the same subject from different and sometimes complementary perspectives.

The chapter then surveys a number of attempts to defend, reinterpret, or reconcile the Torah narrative with modern scientific and historical knowledge, including the works of Nathan Aviezer and Gerald Schroeder, as well as broader approaches such as *Torah uMadda* and Intelligent Design. These efforts are treated with caution where they appear to depend on selective readings, strained harmonizations, tendentious interpretation, or hypotheses that cannot readily be tested. Throughout, the chapter maintains that, wherever factual questions are concerned, impartial method and empirical evidence must take precedence over apologetic or ideological predisposition.

The discussion next turns to modern Jewish thinkers and intellectual movements that have approached Judaism through historical, literary, or critical methods, including *Wissenschaft des Judentums*, R. Louis Jacobs, Robert Alter, Richard Elliott Friedman, Israel Finkelstein, Daat Emet, and R. Adin Even-Israel Steinsaltz. Their contributions are presented as often stimulating and valuable, though uneven in quality and orientation: some are regarded as insightful and methodologically rigorous, some as too attached to orthodox narratives, others as excessively revisionist or influenced by secularist ideological agendas.

The chapter concludes on a personal and reflective note, emphasizing that it is not intended as an exhaustive survey of the literature, but rather as an attempt to place the preceding chapters within a broader intellectual context. It ends with a brief expression of gratitude to attentive readers.

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