Ideas and Opinions Study Guide

Ideas and Opinions by Albert Einstein

Contents

Plot Summary

Ideas and Opinions presents the famed theoretical physicist Albert Einstein's observations on the development of his academic discipline and also his views on such diverse social topics as freedom, religion, education, politics, government, pacifism, disarmament, the fate of the Jewish people, Nazi Germany, and the likelihood of nuclear holocaust.

When writing about he humanities, Einstein is modest about his fame but happy to share his views on disarmament, art and science, and the abuse invited by wealth. Technology gives people enough material security to develop their personalities. Following orders does not cancel responsibility for evil. Everyone should be free to develop intellectually and artistically. Religion must concentrate on moral action. When science and religion respect one another's boundaries, no conflict is possible. Moralizing in school is useless; pupils are motivated by a love of truth.

The Great Depression as a crisis differs from earlier ones because unchecked technology has created massive unemployment; interwar disarmament is essential in the face of mechanized warfare; and later, atomic weaponry intensifies the danger. Two world wars have dangerously militarized America. Security through superior military power is a disastrous illusion. Peaceful cooperation is a must, realized by eliminating fear and distrust, renouncing violence, and empowering supranational bodies to decide security questions.

Einstein with his own Jewishness, sees Zionism not as a political movement but a realization of the social ideal of the Bible, a seat of modern intellectual life, and a spiritual center for all Jews. Judaism is not creedal, but Jewish life has a characteristic stamp. As World War II approaches, Jews know that they suffer for a sacred cause. The land of Kant and Goethe must recover from the Nazi "distemper". Germans are collectively responsible for electing Hitler and must never again be able to threaten humanity.

The final half of the book, "Contributions to Science", discusses the relations between empirical facts and general laws, the nature of theoretical physicists, and the theory of relativity as a two-story building—the "special theory", applying to all physical phenomena except gravitation, and the "general theory", which rests on the special theory. The special theory of relativity recognizes the physical equivalence of all inertial systems, and space and time merge to produce four dimensions just as rigid and absolute as Newton's space. Contemporaries spend twenty vain years searching for a uniform interpretation of the "quantum character" of systems and phenomena. Quantum mechanics has seized a good deal of the truth and will be a touchstone for a future theoretical basis but not the starting point for it. As Lessing says, "The search for truth is more precious than its possession".

Part 1, pp. 1-28

Part 1, pp. 1-28 Summary and Analysis

Einstein is a careful if not comprehensive thinker in the humanities, modest about his fame but happy to share his views. "Paradise Lost" (1919) begins a recurring theme: European intellectuals lose when supporting nationalist regimes. "My First Impressions of the U.S.A." and "Reply to the Women of America" reflect a 1921 trip in which Einstein is struck by American technology, organization, and joyous, optimistic attitude to life.

In "The World as I See It", he puts forth his various opinions and thoughts, ranging from his understanding of the human condition, to God, and to his political ideals. "To the Schoolchildren of Japan" reflects on a 1922 visit, and his hopes that they will avoid his generation's mistakes, although this is crushed by World War II. Finally, "Message in the Time-Capsule", reflecting on the 1939 World's Fair, facetiously hopes future generations will feel superior when they read his words.

Full consciousness is impossible. He states that scientists and engineers should control the military's means of mass destruction and stand up for their consciences. In "Aphorisms for Leo Baeck" (1953), Einstein salutes a helpful, fearless, moral leader.

Part 1, pp. 28-80

Part 1, pp. 28-80 Summary and Analysis

Part 1 examines three subjects, freedom, religion, and education, and addresses seven friends. "On Academic Freedom" (1931) defends Professor E. J. Gumbel, calling on people to read him with open minds. In "Fascism and Science" (1934), Einstein invokes the Italian Renaissance and claims pure scientific research is sacred. "On Freedom" (1940) takes for granted that people should labor as little as possible to maintain life and health and concentrate on their intellectual and artistic powers.

The next two items examine the House Un-American Activities Committee's "Modern Inquisitional Methods" and advocates Gandhi's "non-cooperation". In "Human Rights" (1954), he declares that the struggle for human rights is eternal. "About Religion" contains longer treatises. "Religion and Science" (1930) holds that humans act and think to satisfy needs and avoid pain. In "The Religious Spirit of Science" (1934), he claims that all profound scientists are religious, but not religiously naïve.

"Science and Religion" is a two-part address at the Princeton Theological Seminary in 1939. The scientific method can teach how facts relate and condition one another, but not deduce the goal of human aspirations. Conflict arises when religious people insist the Bible is absolutely truth or when scientists render value judgments.

In "Religion and Science: Irreconcilable?" (1948), Einstein fears that people cannot decide what religion means. Science produces knowledge and means of action, but cannot set goals or pass value judgments. Religion deals with everything not predetermined by heredity, sets ideals, and educates. Speaking in 1951 to the Ethical Culture Society, Einstein observes that humankind has not been enlightened by science or freed of superstition, and technical progress freezes human relations.

The first four pieces "About Education" are short, talking about how people are happiest when launching an enterprise promoting life and culture, urging "happy youth" to appreciate the legacy of countless generations and work to understand all nations and ages. He warns the Progressive Education Association that teaching pacifism without spurning militarism is unrealistic, and believe the US is heading for war. History should interpret the progress in civilization rather than calculating power and success.

"On Education" (1936) is an extended address. With the family eroding, society depends on the schools, not to transfer a maximum quantity of knowledge to students, but to help them think and act independently.

Einstein declares "myopic" and "snobbish" people who read only newspapers and modern literature, for this limits them to contemporary prejudices and fashions. A strong "supranational" organization could be organized to protect the world against nuclear power. Einstein opposes premature specialization in schools, insisting that students

understand and appreciate values and learn to read motives, illusions, and sufferings. Teaching is a valuable gift, not a hard duty.

Einstein lauds engineer Joseph Popper-Lynkaeus as the conscience of his generation, holding society responsible for the fate of each individual. Playwright George Bernard Shaw uses humor and grace to disclose society's follies. Physicist Arnold Berliner helps keep German colleague abreast of developments outside their narrow specializations. The Dutch physicist H. A. Lorentz is lauded for prejudice-free service at prewar congresses of physicists and for striving to restore cooperation through the League of Nations' Committee for Intellectual Cooperation. Lorentz is the "noblest man of our times" and a natural leader. The "Lorentz transformation" leads to the theory of special relativity. Only in later life has Einstein come to appreciate Lorentz's half-skeptical, half-humble attitude toward science.

An obituary for Marie Curie, a friend of twenty years, praises her moral qualities and hardships above her intellectual accomplishments. Einstein praises Gandhi on his seventieth birthday as a politician without "technical devices", a fighter who scorns the use of force, a man of wisdom, humility, resolve, and dignity, who is uplifting his people in the face of European brutality. Einstein mourns the passing of Max Planck, recalling how his work shatters the framework of classical mechanics and provides the basis for further research in physics. Finally, Einstein addresses the Morris Raphael Cohen Student Memorial Fund.

Part 2

Part 2 Summary and Analysis

"On Politics, Government, and Pacifism" opens with an essay written shortly after World War I that calls on lesser scientists not to be isolationists. Economic pressure will force even the most reactionary scientists to cooperate. In "A Farewell" (1923), Einstein explains his relations with the League of Nations' Committee of Intellectual Cooperation, which at least embodies the principle "something must be done". It dates from 1926, when European politicians realize trade barriers must fall, and generous French funding of a permanent Institute hopefully will not prove politically biased.

Einstein claims that uncontrolled technology has created massive unemployment, setting the Great Depression apart from earlier crises. In "Production and Work", Einstein condemns the almost unlimited freedom of the labor market extraordinary progress in methods of production.

Science and technology make life easier but also bring economic dangers that planning must address. Once combat starts, armaments and rules for the conduct of war are meaningless, so war must be repudiated. If the US, England, Germany, and France threaten to boycott Japan for its aggression in China, Japan will yield.

While the state is made for man, not man for the state, it often enslaves citizens by forced military service. The League of Nations and Court of Arbitration provide no security, and unless all nations band together to face aggressors, universal anarchy and terror are inevitable. The fate of the world will be the one the world deserves.

Americans are foolish to be unconcerned with the rest of the world. The US is partly to blame for Europe's condition and will pay. For as long as war is possible, everyone wants to be in a position to win, so disarmament and joint security must occur all at once or not at all. All countries must pledge to accept and carry out the decisions of a court of arbitration

"To Sigmund Freud" is a private letter (1931-32) praising how Freud's binding in the psyche of combative/destructive instincts with those of love and life—and working to end war. Jesus, Goethe, and Kant have also sought this, but great men have little effect on political events, as the intellectual élite lacks the cohesion to attack contemporary problems. Einstein wants to mobilize religious organizations to fight war and support those in the League of Nations who are truly working towards the institution's goals. Freud is the man least likely to be duped by desires, and his critical judgment is supported by a sense of responsibility.

Technology has made international peace a matter of life and death and an ethical imperative for everyone. Only "conscientious objection"—an illegal action—offers any hope. While individuals accomplish little, fifty thousand men simultaneously refusing to

serve could not be resisted. The armament industry is the hidden evil power behind nationalism everywhere. The League of Nations cannot control it without US cooperation.

Pacifism that fails to fight against armaments is impotent. Conscience and common sense must awaken. Political development has not kept pace with economic necessity, and individual countries must subordinate their interests to those of the wider community. Education should keep minorities from regarding themselves as inferior, as has worked with US blacks. Citizens of small states are less tempted by power and brute force.

Addressing the Fifth Nobel Anniversary Dinner in 1945, Einstein observes that as Alfred Nobel aims at atoning for inventing dynamite, so the physicists who make the atom bomb must force the world to see the disaster it faces unless rulers change their attitudes. Physicists tend not to meddle in politics, but know things that politicians do not.

Atomic energy has intensified the old problem of war's inevitability among powerful sovereign states. Britain, the Soviets, and the US should form a world government. Even if tyrannical, it is less worrisome than atomic warfare and world dominance by whoever wins.

While not the father of the release of atomic energy, Einstein foresees it coming within his lifetime, but fails to foresee Hahn's discovery of chain reaction, which makes it practical. Atomic science cannot be organized as a corporation. Unless another war is prevented, it will be destructive on a scale never conceived, but civilization will survive. Americans do not realize that once atom bombs are numerous and cheap, it will be hard for leaders not to use them and Americans will be more vulnerable than Russians. Note later how Einstein's views on survivability change when the H-bomb is developed.

Atomic scientists must enlist churches, schools, colleges, and the press to win over the American people.

Future institutions of learning and research will be too expensive to fund privately, so the military may be entrusted with the taxpayers' money. Two world wars have militarized America, like Germany after Bismarck—which ruins it in one hundred years. Postwar US foreign policy puts non-human factors (weapons, bases, etc.) above human desires and aspirations. Only courageously establishing supranational security will prevent this.

In "Exchange of Letters with Members of the Russian Academy" (1947), Soviet scientists and people appreciate Einstein's humanitarian concern, but see a world government as a panacea.

Einstein thanks his colleagues for their "benevolent attack" and finds their defensiveness and isolationism understandable but disastrous for all. Strong regimes, controlling the armed forces, education, information, and each citizen's economic existence, present a clear danger.

The US is self-sufficient in food and industrial production but always in danger of unemployment. All know that power politics lead to war. Like Plato, Einstein and his colleagues want to use their influence to promote peace and security, pitting reason against passions. Economic antagonism heightens the danger. Nations should concentrate on internal affairs and international issues that cannot endanger security. Because of the atomic threat, mankind must think and act in revolutionary terms.

"Why Socialism?" examines the movement that aims to advance beyond Veblen's "predatory phase" of human development. Society is passing through a crisis, leaving individuals indifferent or hostile. As solitary beings, humans protect themselves by developing innate abilities; as social beings, they give and receive recognition and affection and work to improve conditions in society. Production and consumption are now world-wide and modern individuals know they depend on society, but see their natural rights and economic existence threatened and feel insecure, lonely, and unhappy. Everything about capitalism leads to evils that democracy cannot check in the way a socialist economy and an educational system oriented toward social goals can. Compare this with Einstein's more positive views in 1921 on democracy.

Security through superior military power—whatever the cost—is a "disastrous illusion", which has narrowed foreign policy, established worldwide bases, armed potential allies, concentrated financial power in military hands, militarized young people, limited civil liberties, intimidated, indoctrinated, and restricted public information. Peaceful cooperation is a must. Even a declaration to collaborate would reduce the danger of war.

More than ever, the fate of humanity is in the balance, if preparations for war do not give way to patient negotiation and establishing a strong executive agency. Real peace comes only by systematic disarmament. All should do as Gandhi does, refusing to participate in what they believe is evil.

Commenting on the Universal Declaration of Human Rights (Dec. 10, 1948) and UNESCO, Einstein says that the UN is only a modest beginning, representing governments rather than people, and has no concrete means of enforcing decisions. The fact that discussions take place in the open, however, favors the peaceful solution of conflicts and helps people get used to avoiding brute force. UNESCO's function is to expand cooperation beyond politics into helping various cultures understand and aid one another. The Declaration, establishing universal standards to protect individuals, is, inevitably, a legalistic document subject to endless discussion, but it will exert effective influence once the UN in its decisions and actions embodies its spirit.

Einstein confesses that his perception of grave danger to mankind makes him warn Roosevelt to beat Germany to the atomic bomb. Until nations agree to peaceful, legal solutions to conflicts, they prepare for war—which inevitably brings war. Gandhi has pointed the way in liberating India, showing firm conviction is stronger than seemingly invincible material power.

Part 2 ends with "Symptoms of Cultural Decay", written for fellow atomic scientists to call for the "free, unhampered exchange of ideas and scientific conclusions"—something that US politicians are hampering by preventing American scientists and scholars from traveling abroad and excluding foreign scientists.

Part 3

Part 3 Summary and Analysis

Fourteen pieces on the Jewish people open with a 1929 retort to Dr. Willy Hellpach's criticism. Einstein calls himself "a strong devotee of the Zionist idea", who discovers his Jewishness only after coming to Germany. Only Herzl's dream of a center in Palestine can restore Jews' hearts. Writing to an unnamed Arab in 1930, Einstein proposes a Privy Council comprised of a doctor, lawyer, trade unionist, and ecclesiastic from each community, meeting weekly to look out for the welfare of the entire population. Note: neither side considers this. The OZE society works to alleviate Jews' suffering during the Depression while the ORT seeks to remove centuries of social and economic handicaps.

A long editorial note sets up the four "Addresses on Reconstruction in Palestine". The first three date from Einstein's third visit to the US, 1931-32 and look backward over the ten years since the fourth piece (1921). The fifth dates from 1933 and wraps up the theme. Ten years of work in Palestine exceed all hopes. The last decade has shown Jews the bond that unites them and has purged their attitude towards Palestine of the "dross of nationalism". Their aim is to restore Jewish tradition and to live side-by-side with the Arabs.

For two thousand years, scattered and dispossessed, Jews have had only a past, and lacked the strength for collective achievements until history calls them to establish a home and "awaken the Near East to new economic and spiritual life". Zionism must be not a political movement but a realization of the social ideal of the Bible, a seat of modern intellectual life, and a spiritual center for all Jews. Jews must regain self-respect, learn to glory in their history, and tackle tasks only nations as a whole can perform. Zionists have cleared the way.

Four short pieces from 1934 offer a potpourri of ideas. Elite volunteers are transforming the desert into flourishing settlements. Some Jews are "degenerating" in the Gentile mold, delighting in oppression and challenge the colonizing of Palestine, but this helps revive Jewish life everywhere. Those who want to enslave the world to the state consider Jews an "irreconcilable foe", and Jews must continue to ennoble the human race.

Judaism is concerned only with moral attitudes, and is better incarnated in living Jews than in the Torah and Talmud. Judaism is no creed or transcendental religion. Judaism should not be called a religion because it demands no "faith", just the sanctification of life.

The ghetto guards Jews from social and psychological problems, but young Jews are being exposed through education to ideas that attract them, even as society holds them in contempt. Jews must strive to be civilized Europeans and good citizens.

"Our Debt to Zionism" is a 1938 address to the National Labor Committee for Palestine in New York City. The present oppression exceeds anything since the fall of Jerusalem—and is more troubling because emigration is limited. Zionism has revived the sense of community, saved many lives, and provided joyous and creative work, but it would be better for Jews and Arabs to live together peacefully than for a Jewish state to be created and Judaism damaged, as in the Maccabean period.

"Why Do They Hate the Jews?" is an extended piece that opens with a fable about a shepherd boy, a horse, and a stag that relates to Germany, the Nazis, and the Jews. How can a horse be so foolish as to accept slavery? The Jewish "crimes" used to justify atrocities have changed frequently and pseudo-scientific books brand them an inferior and dangerous race. Knowing the charges are untrue, instigators still use them to bring out the masses' hatred and cruelty.

"Latent anti-Semitism" always exists. The essential character of the Jews as a group includes: ideals of social justice, mutual aid, philanthropy, and tolerance; and, the exaltation of intellectual aspiration and spiritual effort. Given their limited numbers and external obstacles, the Jews' contributions are amazing. Jews have a strong critical spirit, which prevents blind obeisance to any moral authority.

Friends and foes alike says that the Jews represent a race whose behaviors are hereditary. At sixteen million, they form less than one percent of mankind, have minor political significance, are scattered, unable to organize, and can take no concerted action, but enemies portray them as a world power.

With World War II six months away, Einstein writes about a war on Jews, a persecution in Central Europe. Neither intelligence nor institutions can substitute for understanding, justice, and willingness to help others. The rate at which new refugees are being made is alarming.

Jews must consolidate the new State of Israel, which has rescued endangered brethren and created a community that conforms as closely as possible with the ethical ideals of peace, understanding, and self-restraint.

Part 4

Part 4 Summary and Analysis

"Manifesto—March, 1939" opens Part 4 with a declaration Einstein will live only under liberty, tolerance, and equality before the law. There follows an exchange of correspondence between Einstein and the Prussian and Bavarian academies of science in 1933, resulting from his "atrocity-mongering" and resignation. The academies declare their loyalty to the state and do not regret his resignation. Einstein deplores the Academy's demands he put in a "good word for the German people", which goes against all he has spent a life fighting for: justice and liberty—ideals the German people have until recently embraced. He is right to resign.

"A Reply to the Invitation to Participate in a Meeting against Anti-Semitism" (1934) has Einstein explaining why he refuses to join a French rally against German anti-Semitism—no matter how close the issue is to his heart. He is still a German citizen and a Jew, well treated while in Germany, but opposing the "terrible aberrations" under the Nazis. The protest will be more valuable without him as a Jew, for people might question his impartiality. Finally, "To the Heroes of the Battle of the Warsaw Ghetto" (1944) declares that they have fought and died as members of the Jewish nation, strengthening the bonds among Jews of all nations.

Part 5, pp. 217-290

Part 5, pp. 217-290 Summary and Analysis

The long, repetitive scientific section of the book is prefaced by an unsatisfactory synopsis of Einstein's principal physical theories by his former assistant, Prof. Valentine Bargmann. These are the special theory of relativity (1905) and the general theory (1907-16); work on cosmology (1917), the problem of motion (1927 and 1949), the unified field theory (1923-45 and 1953); the quantum theory (1905, 1917), and 1924-25); and the kinetic theory of matter (1902-05).

A year after his election to the Prussian Academy, Einstein tells colleagues that a theorist must both discover in nature principles that can serve as the starting point for deductions, and use their education to infer conclusions. Without general laws, empirical facts lack value. Formulated principles can lead to conclusions that are either false or unverifiable, as in the theory of relativity, which, while "substantially confirmed" for "uniform transitory motion", cannot be extended to "non-uniform" motions. The postulated "general theory of gravitation" cannot be tested using current facts. Physics asks both inductive and deductive questions.

Theoretical physicists use mathematical language for precision and study only the simplest natural events, not expecting completeness. General laws must be valid for all natural phenomenon—including life—and can only be reached by deduction. Max Planck devotes himself to seeing Leibnitz's "pre-established harmony". Colleagues talk (wrongly) of Planck's will power and discipline, missing that he is like a mystic or lover.

Most theories in physics build a picture of complex phenomena out of materials in a relatively simple "formal scheme" using an "analytic" rather than "synthetic" method. They start with something that they discover empirically. The theory of relativity resembles a two-story building: the "special theory", applying to all physical phenomena except gravitation, beneath and supporting the "general theory". That the movement of bodies requires a "coordinate system" has been understood since ancient Greece, and the mechanics of Galileo and Newton rely on one. Their laws are valid only in an "inertial system" (one free of rotation and acceleration), something that does not occur in nature. The special principle of relativity generalizes the definition: "a coordinate system that is moved uniformly and in a straight line relative to an inertial system is likewise an inertial system" and "the principle of the constant velocity of light in vacuo." Both are supported by experience but cannot be logically reconciled until "kinematics" (the relation of time and space) is modified. The special theory relates inert masses and energy and "fuses" the principle of the "conservation of mass" with the "conservation of energy". It points beyond Maxwell/Lorentz to free coordinate systems of dependence on the "state of motion". Developing a consistent theory requires abandoning the "curvature of space" that Euclidean geometry allows. The practical results are so close to Newtonian physics that experience cannot distinguish them, but it is logically complete.

Recalling "Geometry and Experience" (1921) is a long and complex lecture presented to colleagues at the Prussian Academy of Sciences. Einstein put mathematics above other sciences because its propositions are beyond debate and not steadily evolving. The field of "axiomatics" separates the logical/formal—the sole provenance of mathematics—from the objective/intuitive.

Euclid, Riemann, and the general theory of relativity depend on a "tract" (pair) of equal marks made on two "practically-rigid bodies" being equal always and everywhere. Teaching that the inertia of a given body grows as more "ponderable masses" come into proximity, the general theory supports a finite universe, which many physicists and astronomers doubt. Newton's law can calculate the gravitational field and average velocities required for the galaxy not to collapse, so if the actual velocities are smaller, the universe must be finite and its dimensions calculable.

A three-dimensional, finite yet "unbounded" universe can be visualized. Infinite space means that any number of bodies of equal size can be laid side-by-side without ever filling it. A spherical surface, by contrast, forms a "finite continuum" relative to discs stuck to it. The theory of relativity makes it probable that both two- and three-dimensional space are "approximately spherical". How the shadow of a disc cast by a fixed light source on a sphere changes when falling on a two-dimensional plane proves that the plane must be finite, provided the discs are "rigid figures".

The theory of relativity is non-revolutionary and non-speculative, coming about as a result of the desire to make physical theory fit observed fact better than earlier systems. The general theory explains the "numerical equality of the inertial and gravitational mass of bodies", which classical mechanics cannot. Ernst Mach fails to improve on Newton's "ad hoc" introduction of "absolute space", but the general theory of relativity has the physical properties of space affected by "ponderable matter" and allows the problem to be solved in a spatially closed world.

Streams form "serpentine shapes" rather than following the "line of maximum declivity". Baer's law establishes that northern-hemisphere rivers erode on the right side and southern ones on the left. Tealeaves demonstrates what occurs at every bend in a stream: bottom friction slows the current, setting up a "Coriolis force", with maximum velocity at the surface, midstream, and the slowest at the bottom, midstream. Inertia causes circulation to be greatest just beyond the place of greatest curvature, so the "wave line of the meander" increases with the cross-section of the river.

Kepler answers how the planets orbit but not what makes them move. Newton's "differential laws" explain causality and he perfects "integral calculus" as a means of expressing ideas. People are so used to differential quotients that it seems a small step from Galileo to Newton's three laws of motion, but the latter, dealing with what takes place in an infinitely short time ("differential law") applies to all motion. Newton takes the concept of force from statistics and connects it to acceleration by introducing a new concept of "mass". Newton joins the law of motion with the law of attraction to calculate the past and future states of a system from that obtaining at any given moment.

Maxwell's theory of electricity shakes Newton's method, and Faraday introduces a new kind of physical reality, the "field". People eventually fix on the "electromagnetic field" as the final "irreducible constituent" of physical reality until Hertz/Lorentz free the concept of the hypothesis of forces "acting at a distance". This leads to the special theory of relativity. Mass is seen as depending on or being equivalent to energy content. The speed of light "in vacuo" figures as the "limiting velocity". The general law is the last step in the development of the program of the "field-theory".

Truth, applied to science or religion, conveys nothing clear. Scientific research reduces superstition by encouraging cause-and-effect thinking, and seeks the higher order of the world. God is a superior mind revealed in the world of experience. Denominational traditions are historically and psychologically limited and insignificance. These ideas are discussed in Part 1, but the pantheism is new, perhaps because the questioner is not a practitioner of a Western religion.

Einstein admires Kepler for working out the planetary motions with no one's support and the understanding of few. Kepler determines how the distance from the earth to the sun alters in the course of a year, describes the shape of the orbit by noting the "angular velocity" of movement over years, and triangulating with Mars' orbit. He calculates the orbits and motions of the remaining planets—an immense task—and guesses at the laws governing them.

Physics over time undergoes far-reaching changes in its "axiomatic bases" to align more perfectly with perception. The greatest change since Newton comes through Faraday/Maxwell's work on electromagnetic phenomena. By the turn of the twentieth century, the electromagnetic field is generally accepted as the "ultimate entity". Still, successful systems must either compromise with the Newtonian view or break away from both schemes.

Physicists are imaginative. Euclid's geometry is a triumph of reasoning, Kepler and Galileo "ripen" mankind for science by showing that pure logical thinking cannot yield knowledge of the empirical world, which requires experience. Euclid's geometry provides the structure for a system whose empirical contents and mutual relations must be represented in the theory's conclusions. Newton is uncomfortable with "absolute space" and forces that operate at a distance, but they produce results that keep eighteenth and nineteenth-century physicists from exploring other possibilities.

The concepts of a freely invented physics and the laws connecting them are found through mathematics and furnish the key for understanding natural phenomena. To show that pure thought can grasp reality, as the ancients dream, Einstein summarizes analyses of a "metrical continuum" in four dimensions, in which each "principle" is the mathematically simplest concept available. Unlike classical mechanics, this theory is "non-atomic", and modern quantum theory has "spatial functions" that only determine the mathematical probabilities of finding structures at a particular spot or "state of motion". Unfortunately, it requires more than four dimensions.

Concepts acquire content only when connected with "sensible experience", but the connection determines the "cognitive value" of systems of concepts. Space presupposes the concept of the "solid body", which give rise to concepts of spatial relations (touching versus distant), which are obviously real, but not in the same way as the bodies themselves. Independent of the selection of any special body to fill it, the "interval" is the starting point for the concept of space, which exists as a real thing in the conceptual world, but is confined in Euclid's mathematics to solid objects "idealized" (points, planes, straight lines, and segments). Introducing "point-in-space" by coordinates in a "three-dimensional continuum", the Cartesian system gives geometry purpose and puts all surfaces (including the ellipse) on an even footing.

Physicists view space as a "passive container" for events until Faraday/Maxwell show the there exist in "free space" states that propagate in waves as well as "localized fields" exerting electrical or magnetic forces. To avoid the absurdity of attributing physical functions or states to space, eighteenth and nineteenth century physicists invent "the ether", a medium pervading space as a vehicle for electromagnetic and light phenomena. When the gravitational field and inertia are added, the ether becomes the seat of all forces acting across space. Its mechanical properties are a mystery until Lorentz's discovery that fields are physical states of space and the ether becomes logically unnecessary. Only by the genius of Riemann is space freed of "rigidity" and allowed to partake in physical events. The special theory of relativity that all inertial systems are physically equivalent and space and time merge in four dimensions is as rigid and absolute as Newton's space.

The theory of relativity shows how modern theoretical science develops: initial hypotheses grow more abstract while approaching the aim of science—covering the "greatest possible number of empirical facts by logical deduction from the smallest possible number of hypotheses/axioms". Meanwhile, the train of thought from axioms to empirical thoughts or "verifiable consequences" lengthens and grows subtler, leaving the physicist dependent on mathematics. The special theory of relativity leads to the general theory and to the latest offshoot, the "unified field theory." The special theory is based directly on empirical law: the constancy of the velocity of light.

After determining in 1905 the equivalence of all inertial systems, Einstein examines acceleration as an absolute concept. He spends 1908-11 framing a theory whose equations keep their form in the case of "non-linear transformations" of the coordinates. In 1912-14, with Grossmann, he solves how a field-law expressed in terms of the special theory can be transferred to the case of a Riemannian metric, and the differential laws determining the Riemannian metric itself. By late 1915, Einstein returns to the "Riemannian curvature", which links the theory with the facts of astronomy. Today's students grasp this easily, but Einstein endures years of exhaustion before seeing the light.

Part 5, pp. 290-377

Part 5, pp. 290-377 Summary and Analysis

"Physics and Reality" (1936) is a long, dense, equation-rich discussion in six parts with summary. The foundations of physics are problematic, for science is just a refinement of everyday thinking, and scientists are justified in analyzing the nature of everyday thinking. Science is like puzzle solving.

A shift to deductive (logical) thinking frees physics from nineteenth-century false hopes for "induction". The fundamental hypotheses of the theory of relativity have led to an unexpected expansion and broadening of the field theory and superseded the foundations of classical mechanics.

Einstein's generation spends twenty vain years searching for a uniform interpretation of the "quantum character" of systems and phenomena. Quantum mechanics has seized a good deal of the truth and will be a touchstone for a future theoretical basis, but not the starting point for it. The evolution of physics is toward greater simplicity. Light and electricity make it impossible for classical mechanics and field-theory to serve as a basis for physics, requiring a theory of relativity. Nor can quantum theory provide a complete description of the individual physical system or event to serve as a foundation for physics.

Science is an attempt to make the chaotic diversity of human "sense-experience" correspond to a logically uniform system of thought. Physics is that group of natural sciences that bases its concepts on measurements and "whose concepts and propositions lend themselves to mathematical formulation". More than any other branch of science, it has revolutionized mankind's practical life, freeing him from the burden of physical toil. While increasingly specialized, physics is confident it will discover a unifying theoretical basis for all single sciences.

Only after decades of clinging to Maxwell's theory do physicists resign themselves to accepting new field concepts as "irreducible fundamentals." Thus, at the turn of the twentieth century, much progress has been made but establishing a unified foundation for physics still seems remote—and becomes more remote as in the new century two independent and "unfusable" systems develop: the theory of relativity and the quantum theory.

The theory of relativity arises out of efforts to improve the turn-of-the-century foundations of physics. The general theory of relativity originates in an attempt to explain the long-known but never explained fact that inertia and weight—two entirely different things—are measured by the same constant: the "mass".

In 1900, Max Planck discovers that the "law of radiation of bodies" as a function of temperature cannot be solely derived from Maxwell's electrodynamics. Niels Bohr

largely understands the structure of the atom, assuming they have only "discrete" energy values and the "discontinuous transitions" between them are connected with the emission or absorption of such an "energy quantum". De Broglie then hits on a parallel with stationary waves; he also makes intelligible how electrons revolve around the atomic nucleus. Schrödinger shows how fields of force should influence de Broglie's wave fields and their theory represents a wide variety of facts that otherwise appear incomprehensible. It cannot, however, associate definite motions of mass points with the waves as intended. It is born then, unexpectedly and simply, by saying the wave fields should be interpreted as "statistical" statements and "predictions" of results of measurements—rather than descriptions of what is happening in time and space.

Einstein illustrates the general features of quantum mechanics by a "simple example" of radioactive disintegration. The aim of quantum theory is to determine the "probability of the results of measurement upon a system at a given time". Physics is likely to relinquish its statistical theoretical foundation in favor of a "deterministic" one and therefore has no general theoretical basis. Field theory has failed in the molecular sphere; all agree that quantum theory will be acceptable only if translated from field theory.

Language starts when "communicable signs" are linked to "sense impressions". Grammar consists of rules and a "stable correspondence" between signs and impressions. Abstract concepts emerge and language becomes an instrument of reasoning—but also a dangerous source of error and deception. Science strives for acuteness and clarity of concepts. The scientific method furnishes the means for good or evil but cannot set goals; it strives only for clear understanding.

"E = MC2" appears in Science Illustrated, a magazine aimed at the educated layman, in 1946. Einstein begins with two principles from "pre-relativity physics": the "conservation of mechanical energy" and the "conservation of mass". From time immemorial, humans have understood that friction produces heat, but physicists for a long time search for an explanation of the "equivalence of work and heat" and merge it with the conservation of mechanical energy. They then begin wondering if chemical and electromagnetic processes can be included—i.e., all "fields". Until a few decades ago, physicists accept that heating, melting, vaporization, or combining into chemical compounds do not change the total mass of a body, but the special theory of relativity requires it to be merged with the energy principle. The equivalence of mass and energy are customarily but somewhat inexactly expressed as "E = mc2," where c is the velocity of light—186,000 miles per second, E is the energy contained in a stationary body, and m its mass. There is a "vast amount of energy for every unit of mass", but no one notices because it is not given off externally, and the increase in mass when heat is applied is too tiny to detect when the relation is reversed (m = E/c2). Atoms cannot be weighed individually, but there are indirect methods for determining their weights, so calculated values can be verified.

Physicists strive toward a unification and simplification of the premises of physics as a whole. Skeptics may call this a "miracle creed", but it is what has helped science develop. Theoretical ideas do not arise apart from or independent of experience and

require a creative act to come about. Once acquired, a theoretical idea should be held fast until it leads to an untenable conclusion. Einstein does not feel his latest work is sufficiently confirmed by experience, but does think it simple enough in premise to help readers see how speculative endeavors develop, encounter difficulties, and overcome them.

Special relativity and Newtonian mechanics both hold only with respect to "inertial systems", which those who trust in the comprehensibility of nature cannot hold onto. The equations expressing the laws of nature must be covariant with respect to all "continuous transformations"—this is the principle of general relativity.

Every theory is speculative; in those closer to experience this is less obvious than in those further away. As the depth of knowledge increases and the quest for logical simplicity and uniformity in the foundations of the physical theory continue, closeness to experience must be relinquished. The greatest inner difficulty impeding the development of the theory of relativity is the dual nature of the problem: the general relativity has to postulate a "symmetrical tensor field" for gravitation. Apart from the general theory, no one could hit upon the gravitational equations. It can be understood historically why general relativity has been restricted to gravitation, but so little is still known about gravitation to ignore the principle of general relativity in "theoretical investigations of a fundamental character". Einstein does not believe it is justifiable to ask what physics would look like without gravitation. For the general principle of relativity, only six independent differential equations may be postulated from six functions. The remaining four, "Bianchi's identities", assure "compatibility". The system of equations is permissibly "overdetermined" in such a way that the "manifold of solutions" is not critically restricted. The law of motion for the masses is implied in the equations of gravitation.

The problem remains to set up a relativistic theory for the total field. The solution exists for the special case of the pure gravitational field, so one must look at replacing the "symmetrical tensor field" with a non-symmetrical one, yielding sixteen independent components instead of ten. Skeptics point out the purely mathematical problem of showing the "manifold of solutions" to be as extensive as that required by physical theory has not yet been solved, and Einstein agrees.

Without the struggle for insight, Einstein cannot see how a thinking individual could have a conscious, positive attitude toward life. Scientists suffer a truly tragic fate, realizing only a supranational system can save mankind, but accepting the inevitability of his own slavery.

Since antiquity, philosophers resist ascribing physical reality to space. Objectively, events must be localized in time and space. The subtlety of the concept of space is enhanced when it is discovered that there are not completely rigid bodies; all are drastically "deformable" by temperature. "Atomism" eliminates the idea of sharply defined boundaries, eliminating all precise laws of solid bodies touching.

The general theory of relativity arises primarily from the endeavor to understand the equality of inertial and gravitational mass: what non-linear transformations are permitted

to transition an inertial system S1 to a non-inertial system S2 in uniform acceleration. Space as opposed to "what fills space" in classical mechanics has no separate existence. There is no such thing as an empty space; "space-time does not claim existence on its own, but only as a structural quality of the field".

Physicists for decades have been trying to move beyond this to reach a generalized theory of gravitation, to a field law as a generalization of the law for the pure gravitational field. Einstein believes he has found the most natural form but has not sufficiently tested it against experience. Whether field theory of any kind can lead to the exhaustive description of four-dimensional reality is the physicist's focus, and most are inclined to doubt the possibility. Quantum theory holds the state of a system that cannot be specified directly but only statistically. Most believe in a duality of corpuscular and wave structure realizable only by weakening the concept of reality—a stance Einstein finds unjustified.

Characters

Albert Einstein

Albert Einstein in this volume reveals much about his lifetime of looking for insights into the structure of physical reality, which has brought him fame and inspired many groups to honor him and seek his advice and/or support for their causes. The volume does a poor job of revealing the chronology of Einstein's life and career. It suggests he is born in Switzerland and is poorly treated by the rigid Swiss educational system, immigrates to Germany, obtains dual citizenship, and feels well treated despite being a Jew. In fact, he is born in Germany, lives in Italy and Switzerland before returning to Germany during World War I and remaining until Hitler's rise to power. Consulting an outline of his life will be helpful in appreciating many of the things he writes.

His assistant, Prof. Valentine Bargmann lists his major accomplishments as the special theory of relativity (1905) and the general theory (1907-16); work on cosmology (1917), the problem of motion (1927 and 1949), the unified field theory (1923-45 and 1953); the quantum theory (1905, 1917, and 1924-25); and the kinetic theory of matter (1902-05). Nowhere is it mentioned that Einstein receives the 1921 Nobel Prize for Physics. He claims not to have felt himself Jewish until Germans look for scapegoats for starting and losing World War I. He becomes involved in Zionism and travels with Chaim Weizmann, raising awareness—and money—for the Jewish settlers in Palestine. Against nationalism in general, Einstein chooses not to believe Zionism is a political movement. His views on religion are scarcely Orthodox. Einstein visits the US several times from 1921 onwards, before settling permanently as a refuge from Nazism and accepts citizenship in 1940. He alerts Franklin D. Roosevelt to the danger of Hitler's scientists developing an atom bomb before the Americans, but is not otherwise involved in the Manhattan Project. Still, after the war he feels physicists and scientists in general have a moral duty to pull mankind back from the brink of nuclear annihilation. In taking this stand, he must resist right-wing politicians' efforts to stifle "unpatriotic" thought.

Sir Isaac Newton

A great English physicist, mathematician, and astronomer, Newton in 1687 describes gravitation and the three laws of motion, upon which classical mechanics are built. Einstein respects him as the genius placed by destiny at a turning point in the history of the human intellect. He influences Western thought, research, and practice, is a brilliant inventor of key methods, and uniquely commands the empirical material available in his day. Before he perfects the method of integral calculus, no one—even Kepler—finds a way of representing the deeper features of the empirical world. Einstein's special theory of relativity diverges in principle considerably from Newton's, fusing the conservation of mass and the conservation of energy, but yields results so close to Newton's as to be indistinguishable by experience. Newton's great and lucid ideas remain for Einstein the foundation of modern science.

Leo Baeck

A German rabbi who writes about God being more than an "idea", Baeck refuses many opportunities to flee Nazi Germany, and is sent to and survives the concentration camps. Einstein writes a series of aphorisms to celebrate his seventieth birthday in 1953.

Euclid

A fourth to third B.C.E.-century Greek mathematician whose principles of geometry Einstein hails as a triumph of reasoning, which gives the intellect confidence in itself for further achievements. If Euclid fails to inspire a youth, he is not born to be a scientific thinker. Nevertheless, Euclidean geometry and Newtonian mechanics both have to be abandoned to allow for a logically complete system.

Michael Faraday

A nineteenth-century English chemist/physicist, Faraday grasps the artificial nature of all previous attempts to refer electromagnetic phenomena to actions-at-a-distance between electric particles reacting on each other, and formulates a new field concept of electromagnetic effects, precisely formulated by Maxwell.

Galileo Galilei

A sixteenth/seventeenth century Italian physicist, astronomer, and philosopher, Galileo lays the groundwork for Sir Isaac Newton a century later, setting out the three laws of motion by explaining inertia and bodies falling freely in the gravitational field of earth. Einstein calls him "the father of modern physics—indeed, of modern science altogether" because he drums into the scientific world that propositions arrived at by purely logical means are completely empty as regards reality.

Mahatma Gandhi

"The most enlightened of all political men in our time", in Einstein's view, Gandhi's non-violence, refusing to participate in what he believes evil, is the best way for people around the world to participate in eliminating atomic weapons by entrusting them to a supranational government.

Theodore Herzl

Einstein writes with reverence about the founder of Zionism but offers little information about his hero. Einstein is forced by his distaste for nationalism to admit Herzl founds an entirely nationalistic and political movement. Herzl's short career includes planning

and presiding over the first Zionist Congress in Basel (1897) and traveling around seeking support for a Jewish homeland in Palestine.

Johannes Kepler

A sixteenth/seventeenth-century German mathematician and astronomer, Kepler first calculates the laws of planetary motion. Einstein remarks how Kepler works this out entirely on his own, supported by none and understood by few. Kepler determines how the distance from the earth to the sun alters in the course of a year, uses Mars' orbit for fixed triangulation, and then calculates the orbits and motions of the remaining planets, an immense task given the state of mathematics at the time. He next guesses at the laws governing these by trial and error, showing in the end both the mysterious harmony of nature and the need to compare the inventions of the intellect with observed fact.

H. A. Lorenetz

A brilliant and renowned Dutch physicist, H. A. Lorentz establishes the grounds for the theory of relativity at the turn of the twentieth century, but Einstein appreciates him most for his ability to organize scientists from all nations. No one is as free of national prejudice and devoted to the common good as Lorentz. He presides at congresses of physicists before World War I, and after it strives to re-establish the cooperation lost during the conflict between men of learning and scientific societies.

James Clerk Maxwell

A nineteenth-century Scottish mathematical physicist, Maxwell (along with Michael Faraday and Heinrich Rudolf Hertz) develops a set of equations expressing the basic laws of electricity and magnetism that mark the most profound and fruitful change in physics since Newton. He also develops the Maxwell distribution in the kinetic theory of gases.

Max Planck

The long-time professor of theoretical physics at the University of Berlin, Planck advances quantum theory in 1900, determining the absolute magnitudes of atoms and convincingly showing there is a kind of atomistic structure to energy—the basis for all twentieth-century research in physics. It shatters the framework of classical mechanics and electrodynamics. In Planck's memory, Einstein hopes free research, for the sake of pure knowledge, will remain unhampered and unimpaired.

Bertrand Russell

A British philosopher whom Einstein considers his second most-favorite scientific writer after Thorstein Veblen, Russell is exceptional in acumen and simplicity of expression. Einstein accepts to write a reflection of Russell's An Inquiry into Meaning and Truth, in which Russell shows physics both springs from and disproves "naïve realism" (namely, all things are as they seem).

Thorstein Veblen

A Norwegian-American sociologist/economist whom Einstein considers his favorite scientific writer, Veblen deals with the "predatory phase" of human development.

Objects/Places

The Atom Bomb

Einstein foresees the release of atomic energy within his lifetime, but not the first chain reaction which makes it possible. He calls President Franklin D. Roosevelt's attention to the danger of this technology being used by Nazi Germany to develop the ultimate weapon of World War II. After the war, Einstein hopes the bomb's menace, when plentiful and cheap, will intimidate the human race into organizing international affairs to outlaw war. Otherwise, the victor will subjugate all other survivors.

Davos

A Swiss resort for tubercular patients, Davos in 1928 institutes international university courses and invites Einstein to lecture on the fundamental concepts in physics and their development. He precedes his paper with an appreciation for this innovative program.

The Ether

An invention by eighteenth/nineteenth-century physicists to avoid the absurdity of attributing physical functions or states to space, "the ether" is understood as a medium pervading the whole of space and a vehicle for electromagnetic and light phenomena. It is first conceived mechanically on the model of elastic deformations of solid bodies, but this is unsatisfactory. Before field-law is clearly formulated, the gravitational field and inertia are added to the ether, which becomes the seat of all forces acting across space. Its mechanical properties are a mystery until H. A. Lorentz's great discovery that "physical space and the ether are only different terms for the same entity"; fields are physical states of space. Therefore, the ether is logically unnecessary.

House Un-American Activities Senate Committee

Einstein believes American intellectuals are in serious danger from reactionary politicians who have successfully instilled suspicion of all intellectual efforts by "dangling before their eyes a danger from without". They aim to suppress freedom of teaching and starve out those who do not submit. Einstein sees no other reaction than Gandhi's non-cooperation. No one subpoenaed should testify, accepting the risk of jail and economic ruin. Suffering for the cultural welfare of the US, they should not invoke the Fifth Amendment but rather assert it is shameful for blameless citizens to submit to a unconstitutional inquisition. If enough do this they will succeed; if not, the intellectuals deserve the slavery intended for them. The fear of communism is leading greedy US politicians to limit research and teaching, bringing ridicule on the country from the rest of civilized mankind.

The League of Nations

The post-World War I attempt at international cooperation, the League of Nations is, in Einstein's view (and most others) a failure because it lacks any teeth to enforce its will on rogue nations like Hitler's Germany and Japan as it engages in a systematic plundering of China. Einstein includes the US in blame for this situation and warns it not to believe itself safe from the growing problems in Europe. League-sponsored disarmament conferences are a failure, as is in the League-sponsored Committee of Intellectual Cooperation chaired by H. A. Lorentz, in which Einstein participates, striving to restore that cooperation among the worlds' scientists. Einstein remains on the Committee only because it embodies the principle that "something must be done". After World War II, the League of Nations is supplanted by the also weak United Nations.

The Nuremberg Trials

The post-World War II international war crimes tribunal, the Nuremberg Trials reject the defense that an individual acting on government orders is innocent. Instead, they establish the premise that conscience supersedes the authority of the law of the state. Einstein warns fellow scientists that they are responsible for the terrifying weapons being developed and put in the hands of the military. In 1944, Einstein holds the German people as a whole responsible for electing Hitler chancellor even though he has made clear what his plans are for Europe.

Quantum Mechanics

The branch of theoretical physics required by the discovery of inconsistencies connected with Planck's constant and the radioactive decay of atoms at the turn of the twentieth century, quantum mechanics set researchers on a twenty-year vain search for a uniform interpretation of the "quantum character" of systems and phenomena. Heisenberg and Dirac try one approach and de Broglie and Schrödinger another, which prove mathematically equivalent. It provides the key to the interpretation and calculation of a wide group of phenomena of experience, but, as Einstein fears, it is likely to guile scientists into error in their search for a uniform basis for physics. Quantum mechanics has seized a good deal of the truth and will be a touchstone for a future theoretical basis but not the starting point for it.

The Theory of Relativity

Einstein's theory, developed by the principle method, the theory of relativity revolutionizes twentieth-century theoretical physics. Einstein likens it to a two-story building—the special theory, applying to all physical phenomena except gravitation, and the second floor, the general theory, which rests on the special theory. Einstein emphasizes the theory is non-revolutionary and non-speculative in origin, but comes about as a result of the desire to make physical theory fit observed fact. It merely

abandons certain notions connected with space, time, and motion previously treated as fundamentals.

The United Nations

Einstein finds the weak UN formed in 1945 a "modest beginning of international order" representing national governments rather than peoples' representatives, and favors its General Assembly evolving into a true world government to be formed by representatives of the US, Britain, and the Soviet Union and entrusted with a monopoly of military power—including the new atom bombs—to be used to end warfare wherever it breaks out and intervene on behalf of oppressed minorities. The Great Powers' veto power in the Security Council has, through misuse, vitiated that theoretically higher body.

Zionism

Theodor Herzl's dream of a Jewish homeland in Palestine is, for Einstein, the only way to restore Jews' hearts. Einstein prefers not to view Zionism as about power, but about dignity and health. It must be not a political movement but a realization of the social ideal of the Bible, a seat of modern intellectual life, and a spiritual center for all Jews. Zionism in the interwar period revives the Jews' sense of community, saves many lives in Palestine, and has given youth joyous and creative work, but at the cost of nationalist confrontations with the resident Arabs. Einstein believes it better to see Jews and Arabs living together peacefully than to see a Jewish state created, and warns that Judaism will be damaged if it obtains temporal power as in the Maccabean period. If circumstances force the Jews to be burdened by a state, it should be born with tact and patience. Einstein calls on world Jewry to rally behind the creation of Israel in 1948, despite the political problems it raises.

Themes

Responsibility

Among Einstein's most fervent ideas and opinions is that human beings must accept responsibility for their lives. Writing primarily in the period between world wars and to a lesser extent in the aftermath of World War II, he puts little trust or hope in nation states, which inevitably push their populations towards war. Einstein explicitly holds the entire German people responsible for Nazism, because they elect Adolf Hitler chancellor even though his book, Mein Kampf, and campaign speeches make crystal clear the inhuman course he intends to take. Between wars, he calls on Jews around the world to rally behind the Zionist colonizing of Palestine, seeing it partially as a means for Jews to escape Hitler but also as a means of reuniting and reinvigorating the Jewish people behind a positive project. He praises above all heroes of World War I battlefields, the conscientious objectors who refuse to put on a uniform. Most belligerent states persecute them, but they show what is required for peace to be preserved, and all pacifists need to stand up for their rights.

Also between wars, he appeals to fellow scientists to put behind them the political divisions caused by World War I and to return to the spirit of fraternity that reigned from antiquity and particularly since the Renaissance. After World War II, he calls on citizens of all nations to exert pressure on their governments to create a true world government, lest the new United Nations Organization suffer the fate of the League of Nations. Politicians must feel a constituency behind them in order to find the courage to entrust their security to a supranational military force.

On behalf of the physicists and technicians who produce the atomic bomb (with whom he has only the most tenuous of relations, having done no more than write President Roosevelt to warn of the mortal danger of the Nazis harnessing nuclear fission before the Americans), Einstein calls for preventing a worldwide nuclear catastrophe. This body must also stand up for their intellectual freedoms against a US government intent on weeding out traitors suspected everywhere among intellectuals. They should not invoke the Fifth Amendment but boldly state that the new inquisition is unconstitutional and anti-American, and demand the right to work unhindered.

Passion

Einstein insists in Ideas and Opinions that a passion for understanding the mysteries of the universe is the driving force behind science, in the same way and no less intensely than that which underlies art and music. It is the same driving force as what stands behind religion, but has been purified of the dogmatism and superstition that accompany and distort the organized faiths of the world.

Theoretical physicists create new theories in mundane reaction to failures of classical concepts and relations to cover newly discovered facts, but their higher motivations and striving is to find a means of unifying and simplifying the premises of their science as a whole. Every true theorist, Einstein holds, is "a kind of tamed metaphycist", no matter how "positivist" he fancies himself, because he has a passion for comprehension. Skeptics may call this a "miracle creed", but it has driven the development of science since antiquity.

Einstein also summons humanists to get passionately behind the great causes of the periods between world wars and immediately after World War II: disarmament, internationalism, Zionism, and human rights. Gutless politicians need to feel a mass of support behind them if they are to make the difficult decisions necessary to preserve peace. Teachers in particular must have a passion for their profession in order to inspire students to develop the kind of critical thinking that will serve them well on any path in life. Rote methods and overspecialization are lifeless, uninspiring, and intellectually deadly.

Fame

Einstein insists throughout the humanistic portions of Ideas and Opinions that he lacks credentials to speak or write about the topics people want him to address. He cares passionately about freedom of expression, ethics, sound education, disarmament, pacifism, the fate of the Jewish people (encompassing anti-Semitism and Zionism), and the politicization of science, but is at best a dilettante—an admirer, dabbler, or amateur—everywhere except in his specialty, theoretical physics. He acknowledges the oddness of a person so passionate about social justice and responsibility being also such a "lone traveler". He is uncomfortable with the excessive reverence that greets him, particular during his first trip to the United States in 1921, but accepts that people want to understand something about the man who has revolutionized science through his "E = mc2." Self-deprecatingly, he tries to oblige.

Einstein appears least uncomfortable talking about transforming education into something more thoughtful and inspirational than the usual rote exercises, too often turned prematurely into typecasting and specialization. His own experience, first as a misunderstood genius forced in the main to self-educate, and later as a teacher of theoretical physics at Princeton University, inspires him to confess, "Education is that which remains, if one has forgotten everything he learned in school." Einstein is by background little prepared to talk about the Jewish heritage he embraces only after experiencing German anti-Semitism, but he lends his name to raising funds to support the Zionist settlers in Palestine. He speaks out sincerely but simplistically on matters of religion, dovetailing it spiritually with the inspiration of scientists to comprehend the mysteries of the universe. He also lends his fame to overt campaigning for a supranational world government and the preservation of academic freedom in the post-World War II era.

Style

Perspective

Ideas and Opinions contains English translations of materials excerpted from three major collections of the writings of the world-famous theoretical physicist, Albert Einstein (1879-1955), and adds some never-before published materials. The volume appears a year before Einstein's death. Just over half of the addresses and articles deal with Einstein's views on social topics: freedom, religion, education, politics, government, pacifism, disarmament, the fate of the Jewish people, Nazi Germany, and the likelihood of nuclear holocaust. The last section consists of addresses on the evolution of theoretical physics and his famous theory of relativity.

In the first section, Einstein writes apologetically about areas admittedly outside his area of expertise, but forcefully, for he cares passionately about these issues and perhaps hopes his monumental international fame as a physicist will provide the issues a boon. In those sections of the "scientific" section not addressed to colleagues, Einstein also writes apologetically, because the complexity of the matters he covers cannot easily be summarized briefly and in terms accessible to non-physicists.

Each article or address is prefaced with an editor's note on when it is written or delivered and when and where it is previous published. Many present generic comments but are, nevertheless, targeted to concerns of the time and place in which they are prepared. Some are quite closely targeted at a specific audience and and/or are too cryptic for modern readers to appreciate without some research. Unfortunately, only a very few editor's comments help elucidate circumstances well enough to appreciate Einstein's message fully. Nevertheless, the writings provide valuable insights into the evolving and troubled world of ca. 1920-1954. The scientific section ranges from difficult-to-follow to near impossible for those without firm grounding in physics. They are also now quite dated and some of the things Einstein hopes will some day be proved or disproved definitively have been by his younger colleagues. A sufficient number of articles are included, going over the same grounds each time, that the sense of what Einstein is conveying to cognoscenti penetrates "normal" readers.

Tone

Ideas and Opinions is an anthology of Albert Einstein's writings ca. 1920-1954. The first half deals with humanistic subjects that touch the great physicist's heart and about which people or organizations have solicited his opinions. He confesses his unworthiness to address many topics, but then launches in, seriously and yet meekly, trying to be subjective even when dealing with matters like the declining position of European Jewry, the shaky situation of the pioneering Zionists, the response of his German colleagues to Nazi demands to ostracize him, and the need for the international community to control the genie of nuclear power that his theoretical works help loose

from the bottle. From the perspective of history, it must be admitted Einstein is a voice of moderation and conscience in times that foment unbridled fanaticism and immorality.

The second half consists of Einstein's responses to requests for expositions of his theory of relativity and other scientific matters. Invariably, Einstein places his breakthrough work in the context of the great march of science from Newton onward, and confesses the provisional nature of his and his contemporaries' findings. He fervently hopes he or his successors will work out a unified theory. Einstein writes with confidence about these subjects, but humbly and without condescension. He is aware the complexity cannot be reduced sufficiently to fit in a few pages and apologizes for this shortcoming.

Structure

Ideas and Opinions is formally divided into five parts. Part 1, "Ideas and Opinions", consists of seventeen short articles and speeches of a nature too general to classify followed by six "About Freedom", five "About Religion", eight "About Education", and seven "About Friends". Part 2, "On Politics, Government, and Pacifism", consists of thirty-five reflections. Part 3, "On the Jewish People" consists of fourteen pieces. Part 4, "On Germany" consists of five pieces. Finally, Part 5, "Contributions to Science", takes up nearly half the volume. It consists of an Introduction by Valentine Bargmann and twenty-one pieces by Einstein. There is also a brief Publisher's Note and each article or address is prefaced with an editor's note on when it is written or delivered and when and where it is previous published. Occasionally the note is expanded to explain the context. There is no index.

Some of the humanistic pieces are exceptionally short—some under a page long—and the themes at time seem repetitive. They are generally organized chronologically by theme. Many include nonsequitors and abrupt, unsatisfying endings. There are a sufficient number of presentations under each rubric to give the reader an appreciation of Einstein's views on areas of particular concern to him outside his normal area of expertise. Still, the reader is left wondering if the editors have not omitted lesser general writings that do not fit their picture of the great physicist

The writings in Part 5 provide Einstein's responses to requests for expositions of his famous theory of relativity and other scientific matters. In many, he appears to be addressing the humanistic interests in the great march of science from Newton onward and confesses the still-provisional nature of current understandings. Einstein is aware the complexity cannot be reduced sufficiently to fit in a few pages and apologizes for this shortcoming. A sufficient number of articles are included, going over the same grounds each time, that the sense of what Einstein is conveying to cognoscenti penetrates "normal" readers willing to concentrate hard enough. "The Common Language of Science" and "E = MC2" are the most accessible and helpful to non-physicists reading this tome. The book might better have been limited to the humanistic portion.

Quotes

"The ideals which have lighted my way, and time after time have given me new courage to face life cheerfully, have been Kindness, Beauty, and Truth. Without the sense of kinship with men of like mind, without the occupation with the objective world, the eternally unattainable in the field of art and scientific endeavors, life would have seemed to me empty. The trite objects of human efforts - possessions, outward success, luxury - have always seemed to me contemptible." Part 1, p. 9

"The fear of Communism has led to practices which have become incomprehensible to the rest of civilized mankind and exposed our country to ridicule. How long shall we tolerate that politicians, hungry for power, try to gain political advantages in such a way? Sometimes it seems that people have lost the sense of humor to such a degree that the French saying, 'Ridicule kills,' has lost its validity." Part 1, p. 36

"Anybody who really wants to abolish war must resolutely declare himself in favor of his own country's resigning a portion of its sovereignty in favor of international institutions: he must be ready to make his own country amenable, in case of a dispute, to the award of an international court. He must, in the most uncompromising fashion, support disarmament all round, as is actually envisaged in the unfortunate Treaty of Versailles; unless military and aggressively patriotic education is abolished, we can hope for no progress." Part 2, p. 101

"You believe that a word from me would suffice to get something done in this sphere? What an illusion! People flatter me as long as I do not get in their way. But if I direct my efforts toward objects which do not suit them, they immediately turn to abuse and calumny in defense of their interests. And the onlookers mostly keep out of the limelight, the cowards! The silently accepted motto is 'Leave it alone and say nothing about it.' You may be sure that I shall do everything in my power along the lines you indicate, but nothing can be achieved as directly as you think." Part 2, p. 110

"It is sheer irony when the British Foreign Minister tells the poor lot of European Jews they should remain in Europe because their genius is needed there, and, on the other hand, advises them not to try to get at the head of the queue lest they incur new hatred and persecution. Well, I am afraid they cannot help it; with their six million dead they have been pushed at the head of the queue of Nazi victims, much against their will." Part 2, p. 117

"In order to illustrate my meaning, let me record here a personal experience. I recently discussed with an intelligent and well-disposed man the threat of another war, which in my opinion would serious endanger the existence of mankind, and I remarked that only a supranational organization would offer protection from that danger. Thereupon my visitor, very calmly and coolly, said to me: 'Why are you so deeply opposed to the disappearance of the human race?'" Part 2, pp. 152-53

"My part in producing the atomic bomb consists in a single act: I signed a letter to President Roosevelt, pressing the need for experiments on a large scale in order to explore the possibilities for the production of an atomic bomb.
"I was fully aware of the terrible danger to mankind in case this attempt succeeded. But the likelihood that the Germans were working on the same problem with a chance of succeeding forced me to this step. I could do nothing else although I have always been a convinced pacifist. To my mind, to kill in war is not a whit better than to commit ordinary murder." Part 2, p. 165

"Judaism is not a creed: the Jewish God is simply the negation of superstition, an imaginary result of its elimination. It is also an attempt to base the moral law on fear, a regrettable and discreditable attempt. Yet it seems to me that the strong moral tradition of the Jewish nation has to a large extent shaken itself free from this fear. It is clear also that 'serving God' was equated with 'serving the living.' The best of the Jewish people, especially the Prophets and Jesus, contended tirelessly for this." Part 3, p. 186

"Behind the Nazi party stands the German people, who elected Hitler after he had in his book and in his speeches made his shameful intentions clear beyond the possibility of misunderstanding. The Germans are the only people who have not made any serious attempt of counteraction leading to the protection of the innocently persecuted. When they are entirely defeated and begin to lament over their fate, we must not let ourselves be deceived again, but keep in mind that they deliberately used the humanity of others to make preparation for their last and most grievous crime against humanity." Part 5, p. 213

"Turning to the theory of relativity itself, I am anxious to draw attention to the fact that this theory is not speculative in origin; it owes its invention entirely to the desire to make physical theory fit observed fact as well as possible. We have here no revolutionary act but the natural continuation of a line that can be traced through centuries. The abandonment of certain notions connected with space, time, and motion hitherto treated as fundamentals must not be regarded as arbitrary, but only as conditioned by observed facts." Part 6, p. 246

"Before Maxwell people conceived of physical reality - in so far as it is supposed to represent events in nature - as material points, whose changes consist exclusively of motions, which are subject to total differential equations. After Maxwell they conceived physical reality as represented by continuous fields, not mechanically explicable, which are subject to partial differential equations. This change in the conception of reality is the most profound and fruitful one that has come to physics since Newton; but it has at the same time to be admitted that the program has by no means been completely carried out yet." Part 6, p. 269

"The liberty of choice, however, is of a special kind; it is not in any way similar to the liberty of a writer of fiction. Rather, it is similar to that of a man engaged in solving a well-designed word puzzle. He may, it is true, propose any word as the solution; but there is only one word which really solves the puzzle in all its parts. It is a matter of faith that nature - as she is perceptible to our five senses - takes the character of such a well-

formulated puzzle. The successes reaped up to now by science do, it is true, give a certain encouragement for this faith." Part 6, pp. 294-95

"Probably never before has a theory been evolved which has given a key to the interpretation and calculation of such a heterogeneous group of phenomena of experience as has quantum theory. In spite of this, however, I believe that the theory is apt to beguile us into error in our search for a uniform basis for physics, because, in my belief, it is an incomplete representation of real things, although it is the only one which can be built out of the fundamental concepts of force and material points. (quantum corrections to classical mechanics)." Part 6, pp. 315-16

Topics for Discussion

How does Einstein see scientists being motivated?

What are Einstein's views on Palestine and how might they have changed history if adopted?

What are Einstein's views on religion and could they help diffuse contemporary conflicts among faiths and with secularism?

How does Einstein view a balanced, useful life? Was it realistic in the early twentieth century and could it be today?

How does Einstein use humor and self-deprecation to diffuse tension?

How does Einstein lend his fame to good causes and where does he draw the line?

What are Einstein's views on pacifism and are they practical?