Science:
An Instrument for the Working Class to Liberate Ourselves from Capitalism

versus

Intelligent Design:
An Anti-Working-Class Fundamentalist Christian Plot to Destroy Science

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Why is science vital to the working class?

The importance of science to the working class is unlimited. However, the working class needs science first and foremost in order to liberate ourselves from slavery — the slavery of exploitation, racism, sexism, poverty, war, and genocide that are inflicted on us every day by the voracious system of capitalism and its owners, the major bosses. We need a scientific approach to the universe and everything in it, but for now particularly to capitalist society.

After the working class seizes political power, through armed revolution, and organizes a new form of state power to prevent the expropriated capitalists from returning to power or a new capitalist class from arising, there will be an unlimited need for a scientific approach to such things as health, environment, food production, economics, and predicting and responding to natural disasters.

Science is a necessary tool for the working class to liberate itself

The need for science as *a tool for liberation* is the most fundamental reason for the working class and our allies to understand that mastering and using science is in our interest. Without a scientific approach to the question of liberation, the working class is doomed to generations more of misery and early death. Indeed until the working class around the world understands the necessity for science, and begins to apply it in a collective manner to our present condition, we and our children and grandchildren and all future descendants are doomed to suffer endlessly — and needlessly.

Furthermore the working class needs to understand that religion is the enemy of liberation. Any other argument in favor of science and against religion, its chief competitor, floats in the air and is subject to different matters of opinion – or, as communists would say, is idealist, i.e., not based in reality and in our real needs. As we discuss below, while religion has many aspects, some that appear to be positive for the working class, it is primarily a weapon of the ruling class to throw dust in the eyes of the working class about science, so that they can maintain their power and profits.

The most immediate need for the working class is to apply scientific methods to studying and learning the history of social revolutions. This science was founded in the 1800s by people like Karl Marx, Friedrich Engels and V. I. Lenin and has been developed further by many millions of others in collective struggle against capitalist oppression. When the capitalist ruling class passively watches or actively encourages its supporters as they deny that there can be such a thing as a scientific approach to history or revolution, they are trying to stave off the inevitable realization by the working class that the opposite is the truth.

Among the capitalists' supporters, certain Christian fundamentalists go even further. They are trying to prevent the working class from understanding and appreciating the necessity for science primarily by removing evolutionary theory, a central aspect of science, from the public schools and replacing it with Creationist "Science" or with the "theory" of Intelligent Design.

In particular, they claim 1) that evolution is "only" a theory, 2) that a theory is only a guess and not true, 3) that, rather than through evolution by natural means, nature in all its complexity was intentionally developed by a supreme being, and 4) that the only source of comfort in this world of misery is the embracing of religion. Whether intentionally or not, these fundamentalists are only helping to prolong the existence of the capitalists as a class.

So let's proceed to discuss

- the recent history of Creationism and Intelligent Design,
- what science really is,
- how the ruling class uses it,
- what the theory of evolution by natural selection really says,
- the ID "arguments" against evolution,
- how religion and science are related,
- why the working class must defeat this ruling class assault on us, and finally
- why armed revolution for communism is the only way this can be finally achieved.

The recent history of Intelligent Design

Creationism and Intelligent Design attack our children

The publication of this pamphlet is prompted by the ongoing attempts by certain Christian fundamentalists to remove the teaching of biological evolution from the public schools. Such a removal would rob our children of an education in one of the more central aspects of science in the modern world. Even more importantly, it would tend to deceive the working class about the nature of science in general.

As a fallback position, if they could not remove evolution altogether, the fundamentalists have demanded that Creationism, or as they have come to call it "Creationist Science," be taught alongside evolution, so that each of our children would be able to choose which "science" appealed to them more. Creationism is the claim that the universe and all forms of life were created by "God" in one week a few thousand years ago, as the Bible says, and that nothing much has changed since.

While not completely preventing children from learning about evolution, the teaching of evolution alongside its denial would introduce further confusion into what is already a very complex set of ideas, woven together into a magnificent and consistent theoretical framework that requires a significant amount of study and effort to understand. Furthermore it would promote the idea that evolution and Creationism are equally valid alternative points of view, implying that science and religion are likewise equally valid. And closely related, it would blur the lines between science and religion by offering a blatant falsehood in the guise of truth, namely that Creationism is scientific.

The efforts of the creationists have sometimes been successful, at least temporarily. The battle has been going back and forth in Kansas since 1999 when creationists on the Kansas State Board of Education first voted to remove references to evolution in the schools and were then voted out of office. However, they regained office in 2004, and in late 2005, instead of removing evolution or introducing Creationism as such, they put the teaching of what they called "Intelligent Design" into the curriculum. Intelligent Design (ID) is the claim that life is so complex that it could only have been brought about by an act of intentional intelligence, though its advocates are cagey about who or what possesses that intelligence.

Similarly in Dover, Pennsylvania, the school board was voted out of office in late 2005 after having introduced ID into the public schools the year before. A few weeks later, in a court suit brought by the fundamentalists in still another effort to introduce ID into the public schools, U.S. District Judge John E. Jones declared that, even if ID advocates refused to admit that the intelligent designer had to be "God," ID was religion in thin disguise and therefore violated the clause in the U.S. Constitution calling for the separation of church and state.

Indeed much of the opposition to teaching ID in the schools, instead of being based on a rejection of ID itself as just plain false, has been based on a belief in the need for the separation of church and state. Judge Jones, after all, is a Republican churchgoer, but he saw through the creationists' denial that the supposed intelligent designer had to be "God," and he specifically called them dishonest in his lengthy written opinion. Even members of the clergy have denounced ID, saying, "To reject this truth [the fact of evolution] or to treat it as 'one theory among others' is to deliberately embrace scientific ignorance and to transmit such ignorance to our children (quoted in Carroll — all references at the end)."

Creationism is not new

Indeed Creationism was the prevailing view among scientists, let alone religionists, up to the mid 1800s, when Charles Darwin in England published his major book in 1859 called *On the Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life*, known generally simply as *The Origin of Species*. In fact, Darwin struggled to overcome the bonds that creationist thinking held him in, since he himself was an Anglican minister. And *Origin* was his answer to the creationists, who were not just the religious fundamentalists but were the majority of biological and geological scientists of his day.

Before then the concept that present day nature had evolved from earlier forms was certainly not unknown, but it was merely one idea among others in the scientific literature. With this classic book Darwin not only confirmed with literally mountains of evidence (since much of it came from fossils buried in mountains) that evolution had indeed taken place, and over hundreds of millions of years, but he did so by discovering the primary mechanism by which it took place, namely what he called "natural selection."

Intelligent Design, which is Creationism in its latest guise, starts from a slightly different point of view. Whereas Creationism is simply a statement that stands on its own, ID advocates recognize the formidable power of the science of evolution and they throw down the gauntlet in the form of a question: How can organs that are so tremendously complex as, say, an eye (the usual example) arise without some intelligent designer having produced

it? Since they mean this question rhetorically, i.e., they don't ask it in order to find an answer, their position is primarily one of incredulity, i.e., inability to believe that such a thing could have happened.

They are not the first to ask this question. It was earlier posed more than 200 years ago in 1802 by another Anglican clergyman, William Paley, who used the analogy of a pocket watch that he imagined finding on the ground. Anyone finding such a complex mechanism, said Paley, would immediately realize that it hadn't been created by accident, but rather must have been put together intentionally by a thinking being, in this case, of course, a person. He then likened the watch to the eye, and drew the same conclusion that there must have been an intelligent designer, which he naturally concluded had to be "God."

Temporary defeats will not stop the creationists

The temporary defeats of Creationism/ID in Kansas and Pennsylvania have not ended the efforts to introduce ID into the public schools, with the ultimate goal of expunging evolution from the curriculum completely. But it is not only science that is under attack by the fundamentalists. All other religious outlooks are also under attack by them. The drive to force ID down the throats of school children amounts to religious bigotry. After all, ID is only one of many religious ideologies. Below we discuss who benefits and loses from religion in general.

Before we do, we note that there is an interesting parallel between Darwin's major contribution and that of his strong admirer, Karl Marx, that other earth-shaking scientist of the mid-1800s, whose *Communist Manifesto* (co-authored by his friend and ally Friedrich Engels) was published in 1848, just 11 years before *The Origin of Species*. The concept that Darwin discovered and introduced was not evolution, but rather a major mechanism by which it takes place, which also happened to cement the concept of evolution in biological science. Similarly the concept that Marx discovered and introduced was not the struggle between social classes, but rather the ubiquitous nature and the future outcome made possible by that struggle, namely communism — rule of society by the working class.

No scientist ever contributes a new idea out of whole cloth, but rather at most simply advances the science another step, often by resolving growing contradictions among the involved concepts. However, while most scientific advances merely add *quantitatively* to our understanding, there are others that make a *qualitative* change and completely overturn our previous way of looking at the phenomena. Such qualitative advances dwarf the quantitative ones. The theories of evolution by natural selection and ubiquitous class struggle leading to communism are among those giant steps for humankind — far more significant than Neil Armstrong's first step on the moon in 1969.

What is science?

One comment on this section: Abstractions are always difficult to follow by themselves, but just giving examples without the overview doesn't lend itself to much understanding either. One has to inevitably precede the other, so don't be discouraged if this part seems unclear at first. If you reread it after covering other sections of the pamphlet, your understanding will deepen each time you approach it.

Science is a method, not a body of knowledge

Science is a *method* of approaching problems, *not* a body of knowledge. For its long term survival, the capitalist ruling class promotes science not only as if it were finished knowledge, but as if it were comprised of a divided set of many bodies of knowledge. These include, for example, mathematics, physics, astronomy, chemistry, biology, meteorology and geology. They further divide science into the opposing categories of pure and applied sciences, or physical and life sciences, also called hard and soft sciences.

To parallel the categories of science listed above, universities are divided into departments. Other departments in the university, such as languages, art, religion, sociology, anthropology, philosophy, economics and history, are said by the ruling class and its promoters to be something altogether different from science. They either imply or openly proclaim that to speak of a scientific approach to language or art or history is sheer nonsense. However, if science is a method of approaching problems, rather than a body of knowledge, then there is indeed such a thing as a scientific approach to language, art and history.

The scientific method consists essentially of endless cycles of either systematic or insightful/intuitive guesses (hunches, hypotheses) about reality followed by observations or experiments that test how true the hypotheses may be, then, based on the results of observations or experiments (evidence), amended and improved hypotheses and still more observations/experiments that test the truth of the amended hypotheses.

In short, science is an organized example of the process of trial and error. Everyone is familiar with that process, since it is something that each of us engages in every day of our lives. As infants, from the day we are born, we all engage in trial and error to learn to distinguish objects in our visual field, to recognize our parents, to use our hands to grasp or move objects within our reach, to realize that when an object disappears from our field of view it may still exist behind another object, how to know when we are at the edge of a surface so that we don't fall off it, and so on. These are all primitive forms of science, but we generally reserve the term for the organized collective forms of hypothesis and experimentation or observation.

Eventually the process of experiment/observation leads, sooner or later, to results that fail to confirm the hypothesis. Then more and more complex proposals are made to explain the exceptions and to patch up the hypothesis, and often at some point some new insight is needed to improve on, or completely replace, the hypothesis. That insight often comes when someone suddenly recognizes the significance of something that has been staring us in the face, but has gone unnoticed or unquestioned.

Often that insight takes one of four forms: 1) recognition that two completely separate things are actually examples of the same thing, even though they had never been thought about at the same time, or 2) recognition that two things assumed to be the same are actually different – the opposite of the first type, or 3) recognition that something that has been assumed to be true and has never been questioned is actually untrue, or 4) recognition of the possibility or actuality of something that had never been considered or thought possible. There may be others that we haven't thought of, but these give the flavor.

Such insights are the key to major advances in science. The working out of the consequences of such an insight, and on that basis the evaluation of whether or not it is true, is what observation and experimentation are all about.

Some examples of scientific insight

* Isaac Newton in the 1600s had an insight that the apple falling from the tree on earth was undergoing a motion that was qualitatively the same thing as the moon's motion around the earth. Having put these two separate things together he was then able to investigate the phenomenon systematically and propose a law of gravity. His law — still useful, for example, for rocket engineering and astronomy — is that the attractive force of gravity between two objects is weaker the farther apart the two objects are, and in particular that the force weakens by a factor of 4 at 2 times the distance, a factor of 9 at 3 times the distance, and so on, the so-called inverse square law. This is an example of the first type of insight.

* Albert Einstein in the early 1900s had an insight that light was different from other wave phenomena, such as sound or surfing waves, in that light was able to travel in an empty vacuum without requiring a medium. The medium that was previously thought to carry light was called the ether, but Einstein realized that all of the many experiments that failed to detect it failed because it didn't exist. Freed from this false idea, he was then able to investigate systematically and propose the special theory of relativity. This is an example of both the second and the third types of insight.

* Charles Darwin in the early 1800s had an insight that the fossil pattern in rocks and the side-by-side geographical existence of similar but different living species had similar causes, with one changing over time the other over space. This suggested to him that the various forms of life evolved out of other forms, rather than all having been created at the same time by "God." He further realized that when plant and animal breeders were able to develop new breeds of dogs, cattle, or other domesticated animals, by selecting them for some desired feature (strength, size or milk yield, for example), they were doing something similar to what nature had done

automatically (natural versus artificial selection). He was then able to investigate systematically and propose that automatic selection performed in nature could explain the evolution of different life forms. This is an example of both the first and third types of insight, since Darwin had to put different things together and he had to rid himself of the previously unquestioned assumption of simultaneous creation.

* Karl Marx in the mid to late 1800s had an insight that there was a difference between labor time and labor power — the first being the time the worker puts in at the factory each day, and the second being the labor time it takes to produce what the worker and her/his family need to stay alive another day. He was then able to investigate systematically and show that capitalist profit is based on the hidden theft of some of the workers' labor *time*, because the bosses pay only for labor *power* (which is generally less than labor time) but steal the product (whose value is that of the labor time it took to make it). This is an example of the second type of insight. Marx called the difference (between the value of labor time and the value of labor power) "surplus value," which is the essential core of the capitalists' profit. He also showed that the workers' recognition of this exploitation, and of all the horrors inflicted on the workers by the capitalists' control of that stolen profit and their need to continue to expand their profits or go out of business, could lead the working class to overthrow the capitalists and institute an egalitarian communist system of society. This is an example of the fourth type of insight.

The two sides of progress – planting and weeding

Thousands of other examples could be given, but one thing common to all of them is that progress in science is a two-sided process. It not only involves the emergence of new truer ideas, but also involves the recognition and rejection of old false ideas. Indeed all learning involves both of these aspects — the gaining of new ideas and the purging of old assumptions or illusions that are false and hinder understanding. The process is somewhat like gardening – planting and weeding. If any progress is to be made, either in organized science or in an individual's learning, both sides of this process are vital and inseparably linked. And often the weeding takes far more time and effort than the planting — in the classroom, in the laboratory and in life.

The related roles of induction and deduction, another two-sided process

Insight into a new hypothesis to explain observed phenomena is called induction, and the hard work of discovering all the consequences of the hypothesis — both those already observed and those yet to be expected — is called deduction. Induction and deduction are both crucial aspects of scientific work, and while they are different from each other they are inseparably linked. Unless induction is followed systematically by deduction of its consequences and then by experiment or observation to confirm or disconfirm these consequences, induction or insight just remains guesswork, faith, or whatever you want to call it, but it certainly isn't science. It only becomes science when evidence is brought to bear, evidence derived from experiment or observation.

Hypotheses, resulting from induction, are generally the product of intuition, but intuition that is nourished by a relatively full knowledge of the phenomena to be explained and that usually results only after a tremendous amount of work thinking about them and discussing them with many others. Because insights don't arise just because you wish you could have an insight, induction is a *relatively* rare event. They occur all the time, but not as frequently as deductions, which receive more guidance from already proposed hypotheses.

Hypotheses, in fact, generate lots of questions that demand answers, questions that are essentially deductions of the consequences of the hypothesis. There is creativity in both of these opposite processes. Insight into new recognitions is clearly a creative act, but ferreting out questions through the act of deduction is also creative, even if not requiring quite as much concentrated work as induction.

Failing to recognize some of the implications of a hypothesis, and therefore failing to test them, can mislead for a time, particularly those implications that would be disconfirmed if subjected to experiment or observation. Failing to evaluate alternative hypotheses can also mislead. These two types of failure are quite common in certain fields of science, as we discuss below under the topic heading "The enemies of science within the fields of science" in the section headed "The ID attack on evolutionary theory."

All aspects of the class struggle constitute experiments

The concept of experiment is not confined only to manipulations of nature in the laboratory, or to our individual efforts to explore our surroundings. Experiment can be much broader than that. In particular, the working class, in our collective struggles with the capitalist class to survive from day to day, to build unions, to organize revolutions, in short to find collective ways of improving our lives, is continually experimenting in the broadest sense. The Bolshevik revolution that created the Soviet Union in the early 1900s, the Chinese revolution after World War II, the struggles of Native Americans against the genocide committed by the expanding U.S., the struggles of slaves to gain freedom and end chattel slavery, the civil rights movement, all these are not just examples of class struggle. They also constitute experiments from which we have the opportunity to learn strategies and tactics that work and differentiate them from those that are doomed to fail.

But, and this is critical, in order for lessons to be extracted, these struggles have to be studied in a systematic way, and the lessons drawn depend critically on the outlook with which the investigation is approached. Thus capitalists will generally draw one lesson, while the working class, using the outlook developed and popularized by Marx and Engels in the mid 1800s, will generally draw the opposite lesson. Marx and Engels were the first to study the history of class struggles over the millennia and to show that by such study, and by applying the lessons from the class struggle in organized practice, the working class around the world is capable of liberating ourselves from all forms of capitalist slavery and oppression once and for all. But again, as with all experiments, trial and error is central to these efforts. Marx and Engels organized the first communist party in Europe in the mid-1800s, precisely to carry out this task of study (to build theory) and practice (to carry out and test its conclusions), and to study again and engage in practice again, in endless cycles.

When the Parisian workers seized power in 1871 and organized the Paris commune, Marx drew conclusions about what should be done after the workers control the state by examining what the workers in fact did. The commune was defeated and destroyed soon thereafter by the combined armies of the French and German capitalist ruling classes, who had been at war with each other up to that point. They both found the working class in Paris to be the more critical enemy, rather than each other. From their defeat, Marx drew further conclusions about what it would take for workers not only to seize power but to be able to hold it — namely that the capitalist state had to be completely destroyed and a completely new type of state had to be created that was suitable for the working class to rule.

The Soviet and Chinese revolutions constitute evidence that the working class has the ability to seize power from the capitalists. But both these revolutions have since been defeated by their internal errors, and both societies have again been placed under the hammerlock of capitalism, with untold horrors being committed against the workers, who formerly held political power there. The capitalists and their intellectual defenders gloat over these defeats and claim that they prove that attempts to build communism cannot possibly last, and that the international working class ought to give up on any hope for liberation from capitalism. Since trial and error is known to be a part of all scientific endeavor, the capitalists try to convince us that revolution has nothing to do with science. Otherwise the working class might regard these defeats as part of the lessons to be learned in order to improve our strategies and tactics, until one day we will be able not only to seize power from the capitalists, but to destroy that class and hold power permanently.

Levels of organization and levels of analysis

One of the major contributions of Marx and Engels to science has been the explicit consideration of levels of organization of matter and the levels of analysis appropriate to them. Most theories about societies, for example, both before and since Marx, have regarded societies merely as collections of individuals. They have either failed to see, or have tried to hide the fact, that there are laws of operation of societies on the social level that emerge only on that level and are relatively independent of individual desires and actions. So they promote the idea that "human nature" determines how societies function. But capitalism functions differently from feudalism, from communism, from ancient Greek and Roman slave societies and from tribal societies. To acknowledge that different organizations of society function very differently, and at the same time to claim that they depend on an unchanging "human nature," constitutes a logical inconsistency.

Only by studying societies on the social level, as well as on the individual level, and as well as in their relationships with other societies around them both past and present, as well as in their relationships to the changing physical environment in which they develop, can we discover the essential features of the societies. Only then can we understand that what is commonly called "human nature" really is human *social* nature that differs radically depending on the social context in which people are born and develop, or which we create collectively.

Thus the characteristics of societies affects the characteristics of humans within them, just as the nature of humans affects the nature of their societies, but in just what way each level affects the other level requires examination of all relevant levels at the same time. Furthermore one cannot understand a particular individual except in her/his relationship to all other individuals around her/him and to the surrounding social level, again both past and present. Different levels of organization require different levels of analysis. Then, and only then, can the relationships between the various levels be understood. Nor are the laws governing development on different levels simply reducible to those on lower levels, and vice versa.

This is no less true in physics, astronomy, chemistry or biology. In biology, for example, we have to study biomolecules, cells, organs, organisms, species, to name a few levels of organization of living matter, and none of these levels can be understood in isolation from the rest. In physics, to take another example, the temperature of a system of matter has an understandable meaning at the level of the system but also can be understood at the next lower level as the collection of motions of all the atoms and molecules that make up the system—but only when the system is in so-called equilibrium (otherwise the system has no temperature). This was a discovery that was not immediately self-evident. In fact, nothing is self-evident until it is recognized. Only by studying each level as a separate level and in its relationship to all the other levels can we come to understand them.

Marx and Engels first gave practical meaning to dialectical and materialist thinking

As we said above, scientific insights are relatively rare events in the development of human knowledge and understanding. However, insights were given a more systematic foundation and a greater likelihood of arising through Marx and Engels' approach of "dialectical materialism." While Marx didn't invent either dialectics or materialism as a way of understanding the world around us and within us, he and Engels introduced these approaches into the popular mainstream and wedded them together as both necessary for scientific thinking to reflect reality.

Many readers are familiar to one degree or another with the terms "dialectics" or "materialism" or with "dialectical materialism," but understanding what dialectics really means is a long and difficult struggle throughout life in trying to understand what it means in each context we study. Similarly, understanding how to keep in sight a materialist approach to analyzing everything in the world takes a lifetime of practice in doing so. Much of the difficulty is caused by the way capitalist education teaches us to think in ways specifically designed to blunt curiosity and to foster superficial rote answers rather than profound thoughtful questions. In a world run by the working class in its own interests, dialectical and materialist thinking will become second nature.

Let's take materialism first, since it may be the easier to understand of the two. The terms "materialism" and "materialist" are not used here in the narrow capitalist sense of greed for material things. Rather the terms are used in Marx's sense of being rooted in material reality. Materialism, as a philosophical approach to the world, stands opposed to idealism. Again, not "idealism" in the narrow capitalist sense of hoping against hope for the betterment of humanity, but in the philosophical sense that ideas are more important than, and stand apart from, material reality — regardless of where the ideas come from and regardless of how well they correspond to reality. The chief example of idealism in this sense is religion.

The term "dialectics" comes from dialog between two parties representing ideas that contradict each other. The German philosopher Hegel developed dialectics as a conflict between opposing ideas, or more precisely as a conflict between people holding opposing ideas. Marx and Engels broadened that context and developed dialectics as an investigation of conflicts within and between all things, not just two parties arguing different points of view. They developed dialectics primarily as a guide to what questions to ask of things around us in order to understand their inner workings, how they relate to other things and, most importantly, how they develop and change. Without understanding how something develops and changes we can't understand what the thing really is and where it stands in relation to other things.

Asking the right questions is most of the battle. Answers to these questions come from study, observation and experiment, but without questions, and the *right* questions at that, there can be no recognition of answers. Dialectics steers us always to seek, among other aspects, the two-way interaction between any two things, whether on the same level of organization or on different levels, and the internal changes that each thing undergoes as a result of the interaction. If we want to understand the development of anything over time, from an infant to a tree to a society to a chemical compound to the universe, we need to examine the things that make it up (its internal structure), as well as the things that surround it and with which it interacts, both directly and indirectly. To the extent that we leave out consideration of one or another important feature, we will fail to understand the thing. Then eventually we learn what we have failed to take into account by seeing how our understanding goes wrong or is in error.

The critical relationships, both internal and external to a thing, are characterized by conflict, or what Marx and Engels called contradiction. While the word "contradiction" originally meant the conflict between two statements (literally "contra-" meaning "against," and "–diction" meaning "talking"), it has been broadened to mean conflict between any two things or any two aspects of things. Just as the word "dialectics" originally involved conflict between two points of view and was broadened to mean conflict within or between any things.

However, the central usefulness of dialectics is the understanding that all things are continually changing, even as they retain certain features. Just as materialism stands opposed to idealism, dialectical thinking stands opposed to mechanical thinking. Mechanical thinking is everywhere in capitalist society, in writings about science, history, art, psychology, and so on. It takes the point of view that things can be understood in themselves without necessarily having to take account of their relationships with other things around them, either on the same level of organization or on higher or lower levels, or without necessarily having to take account of their history or development over time. In particular, mechanical thinking neglects the changes that things undergo during their interactions with other things, and often goes so far as to deny that there are any significant changes. Mechanical thinking is generally accurate enough when applied to machines (hence the term), but it is often extremely *in*accurate when applied to anything else.

For one thing, mechanical thinking often fails to look for qualitative change or for the conflicts that produce such change. It often regards relationships in a one-sided way, seeing only the effect that one thing has on another, completely neglecting the reverse effect. This outlook derives, at least in part, from the social relationships in exploitative class society.

For example, in a capitalist business the top boss is the active party, and, to the boss, the workers are essentially nothing more than parts in a machine that follow the orders of the boss. This relationship exists in one of its purest forms in capitalist armies. The fact that workers in a factory, for example, see many ways in which to streamline the work process, or soldiers see many ways in which their lives are wasted in unnecessarily dangerous and unproductive and criminal battles, is completely lost in a mechanical outlook. And of course, a mechanical outlook ignores the possibility of mutiny or revolution.

For another example, by bringing up oil from the ground and using it to power industry and transportation, capitalists change our surroundings by causing global warming, pollution, and many other changes in our environment. These changes in the environment, in turn, change us by causing asthma and other lung diseases, or by causing flooding in coastal areas. A mechanical approach leads to denial that human activity in a capitalist society causes these disasters. Therefore the capitalists encourage us to take a mechanical approach.

Still another example is the one-sided outlook of many biologists that the genes or DNA in the cells in our body determine how we behave, without recognizing that not only does our environment participate in shaping our behavior but that both our environment and our activities determine how our genes are activated and used by the cells. This erroneous way of thinking mimics the one-sided top-down mechanical view of the relationship between bosses and workers, or officers and soldiers.

Dialectics, on the other hand, encourages us to see the two-way relationships, and to see how each participant in an interaction is affected by that interaction and how each changes in the process. In the daily class struggle, for example, workers don't just follow orders but also learn how to organize and fight back. By studying history and organizing ourselves, through our communist leadership, to put the lessons into practice, we can vanquish the bosses

and their armies and in the process completely change ourselves as a class and as individuals. This also completely changes the nature of what is left of the bosses, if any survive the revolution.

Finding the ways in which things change requires investigation, i.e., observation and experiment. It isn't automatically obvious just because of using a dialectical approach. But because a mechanical outlook doesn't steer us to look for the ways in which these changes take place, the understanding of these vital issues is often completely missed. There are many exceptions in capitalist writings, but they are not consistent. So dialectical materialism guides the questions, and without the questions the answers are not even sought, let alone found.

Asking the right questions is the key to understanding anything

Learning to ask the right questions is the essence of training in any field of specialization. For example, an auto mechanic and a layperson can both face the same car and wonder why it isn't working properly, but the mechanic is trained through school and practice to ask particular questions and to investigate common causes of the failure. A radiologist and a pediatrician can both look at a chest x-ray, but the radiologist will see things the pediatrician might easily miss because she is trained to ask the right questions of the image and improves with practice. An art historian and a layperson can look at the same painting, but the historian will be able to explain much more about the painting because of her training and practice in the art of that period.

Similarly, communists and non-communists are able to look at the same situation in the class struggle, but the communists will be able to see better how to advance the struggle and swing the situation in favor of the working class because of training in the theory and practice of history and revolution. The essence of that training is learning the way that dialectical materialism leads us to ask the right questions. In each of these examples, the answers, and indeed some of the questions, will vary depending on the situation, but the starting questions are learned through training and practice.

Examples of "right questions" include such things as "Why did the Soviet and Chinese revolutions ultimately revert to capitalism?" or "How did it come about that a few people are extremely rich while the vast majority of the world's people are poor and have to survive by selling their labor power to the extremely rich?" or "How is it that despite the fact that the great majority of U.S. citizens oppose the war in Iraq, the politicians keep pouring money and lives into it and the media keep hiding the truth?"

One of the major assaults on the working class due to capitalist education is that schoolchildren are trained to provide answers to questions already made up by others, but not to develop questions themselves. Many teachers find out the hard way, when they begin to teach, that they now have to learn for the first time how to develop questions that they have never been trained, or trained very badly, to do. That, in many cases, is when they find that they really begin to understand their subject. Furthermore elementary and secondary school teachers, as well as many college teachers, are discouraged from permitting students to develop and follow the logic of their own questions by curricula that force them to cover a certain amount of predetermined material in a predetermined amount of time. So it is not only that the schools fail to teach working class children to develop their own questions. To a very large degree, students are actively prevented from doing so. It falls to communists to relight that fire, and to lead by example and question everything about capitalism and the world.

(For a much fuller discussion of dialectical materialism see the PLP pamphlet "Jailbreak.")

Quality and quantity

All things have both qualitative aspects and quantitative aspects. Without considering quality there can be no consideration of quantity. For example, when we consider the *quantity* of length of a table, the *quality* of length has to be understood first as something that can be compared between two things by holding them side by side — one the table and the other some standard such as a ruler. Or the *quantity* of time between now and when I have to leave for work has to be understood as some *quality* that can be compared between the process of my getting ready for work and some other process used by everyone as a common standard, such as the movement of a clock.

By failing to keep quality in mind, many a professional scientist has arrived at false conclusions by simply manipulating mathematical symbols without keeping in mind to what they refer. And many a student has been left

out of the discussion of an equation in physics because the teacher failed to adequately explain the qualitative aspects that underlay the quantitative aspects. It was through a questioning of the qualitative aspects of time and space, for example, that Einstein arrived at the theory of special relativity as a more accurate description of motion than Newton's theory.

Another aspect of the relationship between quality and quantity is that quantitative changes in some aspect of a thing can lead to qualitative changes in the thing. For example, when heating water, the quantity of temperature of the water sooner or later reaches a certain point where the water changes qualitatively from a liquid to a gas (it boils away). Or when the class struggle reaches a certain quantitative level of intensity, the qualitative nature of capitalist society changes from one ruled by the capitalists to one ruled by the workers, such as with the Russian or Chinese revolutions.

What is a theory?

When an insight (hypothesis) unites many observed phenomena and the number of confirmed deductions (consequences) from that hypothesis continues to multiply, the collection of hypothesis and consequences becomes a theory. For example, the theories of gravity, of relativity, of evolution, or of communist revolution.

One confusing thing is that the everyday usage of the word "theory" is not the same as the scientific usage. The everyday usage just means a guess, as in "I have a theory that the moon landing was faked." Even within science the word "theory" is sometimes misused to mean a hypothesis (guess) that seems plausible but has not been confirmed with evidence. IDers rely on this street use of the word to confuse the working class about evolutionary theory.

Furthermore it's one thing to have a hypothesis that hasn't yet been confirmed. It's quite another thing to have a hypothesis that cannot, even in principle, be confirmed. The latter type does not qualify as science. One example is the claim that there is a supreme being that chooses not to reveal itself directly to anyone. Only guesses that can, at least in principle, be confirmed or disconfirmed qualify as part of science.

Practical obstacles to confirming or disconfirming guesses, such as the difficulty in obtaining a piece of the inner core of Jupiter to discover what materials it is made of, do not disqualify the question from being scientific. After all, today's practical obstacle is often tomorrow's achievability, and even today the proposal can often be made as to how the hypothesis could be confirmed some time in the future. It is the absence of ways to confirm, and not the technical or practical current inability to confirm, that makes the difference between science and non-science.

True, false and the real world

Which brings us to two related questions: Is there such a thing as true and false? Is there a real world apart from our perceptions? These are closely related, because if there is no real world, there can be no true or false. True statements can only be true if they are statements about a relatively stable real world and can be confirmed by anyone with the proper tools. Conversely, false statements can only be false if they are statements about a relatively stable real world and can be disconfirmed by everyone as false. It is one of the mainstays of materialist thinking that there is indeed a real world apart from our perceptions and interactions with it. Thus, trees do fall in the middle of forests whether or not there is anyone around to see or hear the event.

In everyday life all of us certainly show that we believe there is such a thing as a real world and that there are true and false statements about it. For a trivial example, all of us have taken tests in school including questions as to whether a statement is true or false. However, a philosophical argument sometimes develops when the question of reality, apart from our perception, is approached directly. People who argue that there is no such reality are called "logical positivists," a confusingly unintuitive phrase. But even logical positivists act in their daily lives as though there is indeed a real world. For example, challenge any of them to step in front of an oncoming locomotive and their inconsistency will be revealed.

What is evidence?

Evidence in broad terms is any information that confirms or disconfirms a hypothesis. It is the link between the real world and humans who ask questions about it. Evidence can come from direct observation or experiment, in the broadest sense. It can also come from what others say or write. Evidence can be weaker or stronger. In general, what makes it stronger is the number of independent sources and types of evidence that lead to the same conclusion. Furthermore direct observation or experiment is stronger than what others say or write, though the more trustworthy a speaker or author, the stronger the evidence contained in their statements.

However, evidence is subject to perception and interpretation by humans. It is here that we can get it wrong, at least temporarily – and sometimes even for very long periods of time, sometimes millennia. Many textbooks, for example, are simply dead wrong about a lot of things. The worst offenders are history textbooks that are commissioned by the capitalist ruling class specifically to hide from the working class the true history of class struggle and how the working class has won battles against their bosses and/or oppressors in the past.

But history of class struggle is not the only topic that is subject to error or falsehood in textbooks. Even physics, which seems to be the most objective of sciences, since its subject matter is the furthest removed from the struggle between classes, suffers from all the weaknesses that scientists have in trying to interpret and understand the real world.

For example, there have been almost a hundred years of writing on the science of quantum mechanics, a very complex branch of physics dealing with microscopic particles such as atoms and molecules, and that is hard to understand (even for physicists). As a central part of the theory, all the text books always have, and still do maintain that there can be no precise reality in the world of microscopic particles. Despite the fact that this has been disproved, by a few physicists who question everything they don't understand or that seems just plain wrong, all textbooks and most physicists still believe that this view is correct (Bohm, Smolin, Beller).

How are evidence and proof related?

Proof can be thought of as the product of enough evidence. However, proof is never absolute, and is only approached closer and closer by more and more evidence. In other words, evidence is to proof as practice is to perfect. There comes a point in a concert pianist's development when her practice allows her performances, *for all practical purposes*, to be perfect, at least in hitting the correct notes. There also comes a point in the accumulation of evidence for a theory when, *for all practical purposes*, the theory is proven, and denying its validity without counterevidence, or without an alternative theory that explains all the evidence even better, is just dishonesty, ignorance, wishful thinking, or some other less than valid approach to the real world.

However, even theories for which evidence has mounted for long periods of time (and which *for all practical purposes* have therefore been proven) can one day be replaced by newer theories that deny their essential features, even while retaining some of their superficial aspects. This can occur when finally some new evidence or a new theory arises that convincingly debunks it, or at least reveals its limits of applicability. For example, Einstein's special relativity theory replaced the Newtonian view of physics, that had held firm for over 200 years, by revealing its limits of applicability (namely to velocities much less than that of light) even while retaining certain aspects of the Newtonian view to high degrees of approximation.

Because proof can never be absolute – whether in science or in any other human endeavor – in criminal trials, for example, the jury is instructed by the judge that the standard of proof of guilt is "beyond a reasonable doubt." In other words, in that context proof beyond a reasonable doubt is proof for all practical purposes. But that's the best that we can ever do, recognizing that the verdict, like a scientific theory, may later be shown to have been wrong in at least some respects.

Can science ever be completely objective?

In particular, is science so objective that everyone ought to be able to come to agreement? The short answer is No.

In the practice of science there is much room for insights and intuitions in the formation of guesses, and there is much room for choosing such things as which questions about reality to pursue, what conceptual framework (theory)

to use to relate new evidence to already established guesses, and which evidence to accept as relevant and which to reject as irrelevant.

But the source of these things is often to be found outside science. It is these things that prevent science from being a predetermined process on which all objective people/scientists can come to agree. While the real world is the final arbiter of answers to those questions that get asked, it does not determine which questions get asked and which ignored, or how the answers are interpreted and related to other things in the world.

The claim that Marx's theory of revolution cannot be scientific, or more generally that an analysis of history cannot be scientific, is based on a fallacy about science. The fallacy is that science is completely objective while Marx's theory of revolution is biased toward the interests of the working class and against the interests of the ruling class. However, the bias in Marxist theory is no more nor less than that in any science. Bias simply guides the choice of questions to be asked, how to view evidence, and which evidence is relevant and which irrelevant. These choices are necessarily common to all science. It is still the real world that is the final test.

The working classes in Paris in 1870, in Russia in 1917, and in China in 1949 have shown that they are capable of overthrowing capitalism and organizing a new world in their own interests. Since through these revolutions the working class, so far, has only achieved temporary political power, there is clearly much more to learn about how to seize and hold that power. But, as we have said, trial and error is a necessary part of all scientific processes.

The capitalists claim that the temporary nature of these revolutions is evidence that communism cannot work and therefore should not be attempted. This is paralleled by the ID claim that the existence of unanswered questions in evolutionary theory is evidence that evolution is only a guess and not a fact. Both of these false claims overlook the fact that all advances in science and society are a result of trial and error and never fall from the sky fully formed and perfected.

While bias is unavoidable in science, there is bias that leads away from the real world and bias that steers toward it. The only bias that is harmful is that which prevents a theory from being an accurate reflection of the real world. It is therefore not enough to accuse a scientific opponent of bias, without showing that her/his conclusions are not supported by the real world while yours are.

However, this formulation has to be modified. We really mean the only bias that is *destructive to science* (rather than "harmful") is that which prevents a theory from being an accurate reflection of the real world. After all, in saying "harmful" rather than "destructive to science" we were implicitly taking the point of view of the working class. But what is harmful to the working class is generally beneficial to the capitalist class, since they are a small class that could not possibly exploit, oppress and rule over the vast majority of humanity without the corruption of science that leads the working class away from reality and the search for liberation.

Pseudoscience and religion

To help understand what science is and isn't, we need, among other things, to understand pseudoscience, i.e., efforts *within* fields of science that fail to measure up to the requirement for objectively weighing evidence. Pseudoscience engages in only partial application of the scientific method to partially false content. We will say more about pseudoscience below, but suffice it to say here that it is more similar to, than different from, religious thinking (faith without evidence). Pseudoscience acts to oppose science from *within* various fields of science, while religious thinking acts to oppose science from the outside. Therefore pseudoscience is the more dangerous, since it has the surface appearance of science, like the fabled wolf in sheep's clothing, harder to detect and therefore harder to defeat. It is like the Democrats or trade union officials who are enemies of the working class from within, pretending to be the allies of the workers but really believing in and carrying out the will of the capitalists. PLP publications, particularly our newspaper CHALLENGE, are brimming with examples of these enemies within.

Science is a cumulative and collective process

A central aspect of science is that it is a *collective*, rather than individual, endeavor of human beings. The main thing that separates humans from other animals is that humans pass on their discoveries about the real world not just to their immediate offspring, but from generation to generation, and in cumulative fashion. Books, pictures, schools,

and many other forms of continuity allow humans to build on the achievements of our ancestors so that we are not consigned to continual repetition, generation after generation, of the same questions or even, more importantly, the same oppressive conditions of life. If mistakes are repeated over and over again, it is because the problem is not being approached scientifically.

Despite the mythology fostered by the ruling class and most science historians that certain individuals such as Newton, Einstein, Darwin, Leonardo, Aristotle, or even by implication Marx are somehow qualitatively different types of humans (geniuses) from the rest of us, the fact is that none of them achieved anything outside the context of the social relationships of their time or without the help of many other humans with whom they were in direct or indirect contact. Their insights were the product of years of intense social exchange of ideas with others, focused concentration, and consistent hard work.

And their contributions are just the tip of an iceberg. The submerged part is the millions upon millions of scientific discoveries and inventions by uncelebrated workers and tradespersons over thousands of years. For the most part they were illiterate, and therefore they could not record their inventions in print. So science historians, for the most part, have ignored their contributions. Moreover much of the written European and U.S. history of discoveries and inventions over the millennia overlook the overwhelming contributions from Asian, Middle Eastern, African, "New World" Indian and Latin American peoples (Conner).

And finally, the only way that the likes of Newton, Einstein, Darwin, Leonardo, or Aristotle can be (falsely) considered unique and different types of human beings is by considering them not only outside the context of everything else accomplished in science by millions of others, but by considering their scientific contributions outside the context of themselves. That is, Newton, for example, was mainly ignorant when it came to history or biology or poetry or things outside certain fields of physics. It is only by considering the one or, in the case of certain other "geniuses," the few areas in which they made significant contributions (along with millions of other unsung heroes) that the illusion is created that they are somehow different from the rest of us.

Marx is one of a handful of exceptions who excelled in a wide variety of fields. But he didn't do this because he was somehow differently endowed, but rather because he was motivated to help resolve the injustices he saw all around him and he used the intellectual framework of dialectical materialism to see the interrelationships among all aspects and levels of human endeavor and of the natural world. For example, in order to expose the essential feature of capitalist economics as hidden theft from the working class, he had to study mathematics, history, economics, philosophy, and other branches of science. Meanwhile, in addition to some of these, his friend and colleague Engels studied and wrote about anthropology and natural science. *We can all aspire to achieve similar successes if we are motivated and use the scientific tool of dialectical materialism.*

The best scientists, without even knowing they are doing so, also use either a dialectical or materialist approach, or both, to their respective fields. One linguist, for example, when asked recently if he was a Marxist, responded that he didn't know, since Marxism deals with so many different aspects of the universe. He simply fell into a dialectical materialist approach to linguistics because it made the most sense to him and allowed him to explain a wide variety of aspects of language acquisition.

Scientific discoveries only take root when the time is right

Besides the collective exchange of ideas and hard mental labor over many years, sometimes centuries, the recognition of the law of gravity also required that the social context be such as to permit this discovery to catch on, gain other followers and bear fruit, thus becoming the basis for the development of still further understanding of physics.

The necessity of the preparedness of social conditions (that the times be right) finds confirmation in the fact, for example, that more than half the inventions and discoveries attributed to European inventors and scientists had long since been invented or discovered in China, sometimes centuries earlier. They had been brought to Europe by traders and other travelers, but lay dormant until the times called for them. Examples include the printing press, the biology of the silkworm, spinning wheels and other textile-handling machines, mechanical clocks, suspension bridges, oil drilling techniques, steel, gunpowder, iron plows, ship rudders, the compass and multiple masts, to name only a few (Conner).

Summary

So in summary, communists and almost all professional scientists start from the point of view that there is indeed a real world apart from our perceptions, and that every single one of us acts in our daily lives as though we are well aware of this fact, regardless of what we claim to believe, or even believe we believe. If there is a real world, then there are indeed true and false statements about it. If there were no real world, truth and falsity would have no foundation. But since there is, they do.

The practice and building of theories, which again feed practice that improves theories, in endless cycles, is rooted in the reality of the world around us and outside of us. This merging of theory and practice constitutes a materialist approach to our surroundings and to ourselves. In looking to construct theories, the most successful approach is to consider everything at every level that may impact on the subject at hand, and the interrelationships and interactions among them, which is the essence of a dialectical approach. Theories are less successful to the extent that they neglect either a materialist or dialectical approach.

The best science then is a method for separating truth from falsity, about anything, including history, art, or other so-called humanities. Of course, there are additional aspects of human endeavor other than truth and falsity, such as esthetics and taste. But these we will only mention in passing, since the purpose of this essay is to discuss science and the different ways in which it is useful to the ruling class and to the working class. The main embodiment of the idealist approach to the world is religion, which will be discussed later in the pamphlet.

How is science important to the ruling class?

We have already discussed *why* science is important to the working class but discuss here *how* it is important to the ruling class. We make this distinction because the importance of science to the ruling class is limited, while the importance to the working class is unlimited. For the ruling class, their use of science is essentially limited to two functions: a) the production of their profits and b) the maintenance of their power over the vast majority of humanity.

The ruling class is willing to support with jobs, research grants, awards, publishing opportunities and publicity those scientists who develop those aspects of science that result in profit-making or war-making or surveillance technologies. Even the exploration of space, on which the ruling class has spent vast amounts of our money, is fundamentally intended for their military purposes. Research on health and health care also consumes a certain amount of our money, but it is primarily directed at keeping workers and soldiers just healthy enough to be able to produce capitalist profits and fight wars of conquest.

On the other hand, the ruling class has little use for that small minority of scientists who think more deeply and broadly and who question the very foundations of accepted theories when, regardless of how successful, they seem flawed. Because of the risks to their own careers, such scientists are few and far between. Since they often cannot get or hold positions in universities, they almost always have to have independent incomes so they can think, write and publish their ideas on their own (Smolin).

Technology explodes under capitalism

The current technology explosion had its roots in the European renaissance of the 1400-1500s, which, in turn, borrowed, or more appropriately stole, from other cultures in the Middle and Far East, the Western Hemisphere, and Africa. It was during the renaissance that there was an explosive advance of scientific theories about physics, chemistry and astronomy, encouraged and made necessary by the commercial and economic needs of the rising capitalist class.

On the other hand, it was also during that era that this explosion of science was most threatening to the current feudal ruling classes – the landowners, the king and the church. Among many others, Galileo, an Italian physicist, was threatened by the church with burning at the stake if he did not recant his theories. For example, he said that Venus, which he could see through his newly invented telescope, was like Earth and not a heavenly body in a

different class from Earth. The church relied, and many churches still do, on the concept of a heaven apart from earth, where those who obey the clergy during life could count on spending eternity after they die in a degree of comfort unknown to them during life. Any statement that tended to dissolve the concept of heaven was a threat to the church's power. Galileo backed off, but countless other scientists and philosophers were, in fact, burned at the stake.

In contrast, the rising capitalist class found science to be useful for the development of the means of production, but only certain scientists were supported and only research into some questions was funded by the capitalists. Through funding, the ruling class could attempt to determine the direction in which scientific progress would be made. But this manipulation, while powerful, has its limits. There was, and there continues to be, an ever-present danger of scientific insights that could threaten their ruling position or their profits.

For example, the current U.S. administration, with even less style and finesse than most, co-opts and hires scientists to debunk the scientific discovery that global warming is taking place and is largely due to CO_2 emissions from fossil fuels (coal and oil). It has taken the U.S. out of the Kyoto Protocol that most nations (169 of them as of December 2006) have signed and ratified, a treaty designed to decrease these emissions. The U.S. has signed but never ratified the Protocol, which means, according to the Protocol, it is not bound by it.

The current U.S. administration would rather spare the short-term expense and protect the current profits of its friends in the oil and manufacturing industries. It refuses to prevent the increase in disastrous floods, fires, erosion and loss of wetlands, and to preserve the environment for future generations. In order to throw pixie dust in our eyes, the hired scientists raise false questions about the scientific conclusions of the vast majority of the world's investigators in this field — that the continuation of preventable global warming will have devastating consequences for humanity, not to mention the rest of plant and animal life forms. Thus the ruling class misuses and lies about science whenever real scientific conclusions get in the way of its profits and power.

As it became clear that the position of the capitalist ruling class could be threatened by everything that Marx researched, wrote about and put into practice in the 1800s, he received little official support. To the extent that he supported the Union side against the southern Confederacy of slave owners during the Civil War in the U.S., he was employed as a correspondent by the anti-slavery *New York Tribune* newspaper. On the other hand, he was only able to develop the theory of capitalism, in his earth-shaking book *Capital*, because his friend and collaborator Engels inherited a factory from his father and used the profits in part to support Marx and his family during those years. Because he was funding the beginning of the end of private ownership of factories, the Engelses of the world have been extremely rare. But the rarity of such individual exceptions only highlights the rule that virtually all capitalists will use and misuse science to stay in power, even when that means killing millions in near genocidal wars.

Capitalist class relationships act as a "fetter" on scientific development

Because the world's capitalists rule everywhere, and because their use and financial backing for science is limited to their own class needs (profits and state power), this acts as an obstacle to — or, as Marx put it, a fetter on — the development of science. If investigation of scientific questions is funded by the rulers primarily if it will increase their profits or enhance their war-making ability or other needs related to maintaining their class dominance, the vast majority of questions that arise cannot gain their backing, and few women or men can afford to devote the time and effort to pursue them without such backing.

Furthermore, at a deeper and less easily detectable level, even with respect to those investigations that *are* permitted, most scientists apply an inadequate range of levels of scientific analysis. Without necessarily realizing it, their scientific thinking suffers from a pervasive capitalist outlook on the world that is far too narrow to conquer the problems. This narrowness of outlook pervades virtually all aspects of science in capitalist society and only serves the interests of the ruling class by preventing the more profound questions from being asked, such as "Why are we poor?" or "Why do workers from different countries or religions often hate and try to kill each other?"

As an example, most scientific handling of major public health issues — such as AIDS or TB or Mad Cow or other infectious diseases — is confined to looking for the microscopic agent of the disease (a virus or a bacterium or some other agent), the place where it was originally transferred from animals to humans, what causes it to spread and drugs and other methods that can combat the disease. The findings that result from these investigations may be

perfectly valid as far as they go, yet, at a social level, scientists fail to recognize that the underlying root of the disease lies in capitalist class relationships and the extreme impoverishment of the vast majority of the world's population that these relationships require. The scientists are therefore blinded to the reality that until capitalism is "cured," diseases such as AIDS, TB or parasitic diseases can at best be limited in one location or another but can never be eliminated from the earth.

And now let's proceed to discuss evolutionary theory, a theory that first arose in the younger days of capitalism and continues to be developed, but today is still under attack from fundamentalist religious forces.

Evolutionary theory

The science of evolution is central to science in general, particularly because it is fundamentally about qualitative change. Fundamentalist religious attacks on evolution underscore the central importance of religion as a weapon in the hands of the capitalists, particularly because the last thing the capitalists want is change – i.e., change in the current form of social organization in which they alone rule. And Creationism and Intelligent Design are nothing if they aren't a statement that once the various species were created they have never changed.

We discuss religion more fully below, but here we discuss the essential features of evolutionary theory. We also briefly discuss the evidence that led Darwin to confirm the *fact* that evolution has taken place, and to discover what he thought to be its primary mechanism, natural selection.

There are basically two different levels of evolution: *micro*- and *macro*evolution. *Micro*evolution refers to changes *within* a species that can happen over time from sheer random effects called drift or from natural selection in the face of changing environments or other forms of selection, such as intentional selection by animal breeders or lab experimenters (more on this below).

*Macro*evolution, on the other hand, refers to the emergence of new species out of old ones — qualitative change. Darwin was particularly concerned with the macro level, though it can only be understood in its relationship to the micro level. There are many excellent and manageable reviews of evolutionary theory — for example, see Eldredge, Arthur, Carroll or Ruse. Of course, Darwin is also an unbeatable source on the original theory, but the more modern works contain information on the progress since Darwin.

Who was Darwin and what was the theory he presented in 1859?

Charles Darwin, born in England in 1809, started as a geologist, as well as an Anglican minister, who trained himself to be a naturalist and who observed detailed facts of nature with a keen eye. Everywhere he traveled he kept a notebook in which he recorded thousands of details. He developed an encyclopedic knowledge about the earth and its rocks and mountains, as well as about plants and animals all over the world. In his early twenties he took off on a 6-year voyage on a ship called the *Beagle* that traveled around the world, spending much time in South America and the Galapagos Islands in the Pacific Ocean off the coast of Ecuador. It was only armed with this vast knowledge that he was able to detect patterns to which those with lesser knowledge and experience were completely blind. Such knowledge, gained by long and laborious study, is a prerequisite to insights that chart new pathways in science.

Surrounded by predominantly creationist thinking in the first half of the 1800s, Darwin gradually developed the insight that there had to be some natural process that explained many facts that seemed unlikely to be the work of a supernatural creator with a mind and with goals. For example, he wondered why two different species of rheas lived in neighboring parts of southern and western South America. (The South American rhea resembles the African ostrich and the Australian emu, the class of large flightless birds.) He saw in that pattern something similar to the way fossils of long dead creatures were trapped in layer upon layer of earth and rock. Neighboring regions contained different species, with similar species succeeding each other in layers of rock that were more and more superficial and therefore had been laid down more and more recently.

His insight led him to suppose that, rather than all these creatures having been created at the same time by "God," they seem to have been created at different times and in different places, which cried out for an explanation. He

didn't think it likely that "God" would have bothered to lay down such a pattern across neighboring places, and certainly, he thought, "God" wouldn't have laid successive species across successive portions of time.

He also noted that plant and animal breeders were able to select plants or animals for certain desirable features and selectively breed them to develop purer breeds. Of course, in order for breeders to be able to select different features that they desired, there had to be a certain amount of variation among the various cows or crops or dogs to begin with. For example, cows that gave more milk, or crops that yielded more food per acre, or dogs that could herd sheep. After many generations of selective breeding, different varieties of cows or dogs arose. Just think of the many breeds of dogs, all of which belong to the same species and can interbreed, barring such physical difficulties as might be faced by a Great Dane and a Chihuahua.

Darwin wondered if an analogy to this selective breeding could happen in nature without anyone's trying. He found that tremendous variation did indeed exist in nature ready to be selected. He also guessed that if selection could lead to different breeds ultimately becoming so different from one another that they could no longer interbreed. If this occurred then new species would have arisen.

The definition of "species," as with *all* definitions, has some fuzzy edges (i.e., contains exceptions), because the real world has fuzzy edges. As a rule, for animals at least, species is often defined as a group within which interbreeding can take place between pairs of opposite sex, but outside the group no interbreeding is possible. To sharpen the definition it is often added that in order to be a species the group must share common ancestors. However, there are exceptions to this definition, as is true for all definitions of things in the real world. For example, lions and tigers are different species, but they can mate. Furthermore their offspring are usually not sterile, i.e., they, too, can reproduce. Horses and donkeys, likewise, are different species but, while they can mate, their offspring are usually sterile, though not always.

Nature contains exceptions all over the place, but this should not prevent us from using definitions that are good for all practical purposes. We can always examine the exceptions separately and learn even more from them. In that regard, definitions are like proofs. They can be valid for all practical purposes yet always will have limits of applicability. As one philosopher has said, it is impossible to pick the precise moment when day turns into night, or night into day; nevertheless no one has any trouble distinguishing night from day. Indeed they are as different as night and day.

Darwin realized, not long after his return from the *Beagle* voyage, that this could happen through something that he logically termed natural selection, as opposed to deliberate human (artificial) selection. And such change in the appearance, size and behaviors of different varieties would constitute microevolution, i.e., change. Recognizing the reality of evolution itself was not so difficult. It was the problem of how microevolution could lead to new species (macroevolution) that occupied most of Darwin's mental efforts. Once he came up with an answer he was afraid to publish it, for fear that he would be forever barred from the halls of science, particularly since it not only flew in the face of current scientific thinking, but also in the face of religious teachings.

However, about 20 years later in the late 1850s Darwin received a manuscript from Alfred Russel Wallace proposing the same theory of natural selection. It was then that he decided to write and publish his major book *On the Origin of Species*, which came out in 1859. But being scrupulously honest, he first jointly published a paper with Wallace the year before, laying out the theory and giving Wallace full credit for his similar discovery. In his book Darwin enlarged on the details and tried to anticipate all the objections he could think of and answer them in detail.

As it turned out, over 40 years earlier a U.S. physician, William Charles Wells, had put forward an essentially similar theory of natural selection, but Darwin had not heard of it until he had already published three editions of his book. In the fourth edition he gave Wells credit for the much earlier discovery.

This coincidence of independent discovery by more than one person is not at all unusual in science. Rather it is the rule when the times are right for a discovery to take place, and take root. However, in this case Darwin's book went far beyond both Wells's and Wallace's thinking. He even disagreed with Wallace on certain aspects. One important disagreement was whether natural selection was the *main* mechanism of evolution, as Darwin maintained, or the *only* one, as Wallace claimed (Gould).

Unfortunately one of the weaknesses in Darwin's book lay in his admiration of Thomas Malthus, a political economist and also another Anglican clergyman who was born some 43 years earlier than Darwin. Malthus theorized that since food production increases more slowly than the human population, creating shortages and famines, increasing numbers of people would starve to death. In other words, competition among people for scarce food supplies would play a key role in determining who would survive. His premise was completely false. Among other errors, with advances in the science of food production over 200 years later, increases have not only kept up with population, but can exceed its growth. The only thing that creates starvation among large sections of humanity is capitalist production for profit instead of for need.

However, from Malthus's hypothesis, and from the competition of capitalists that he saw all around him, Darwin drew the false conclusion that all plants and animals are engaged in a competition *against each other* for survival, with only the conquerors surviving. Following the publication of Darwin's theory, Herbert Spencer an English philosopher, extended the theory to human society, which later came to be called social Darwinism, in which he justified dog-eat-dog capitalist competition as no more than a reflection of nature. Interpreting natural selection in this way, Spencer coined the term the "survival of the fittest," which is a completely unnecessary part of the theory of natural selection, but which even Darwin adopted in a later edition of his book. The survival of the "fit" is all that is needed at most, and for animals who help each other, such as humans, the definition even of "fit" has to be expanded greatly. But this type of unscientific thinking led directly to eugenics toward the end of the 1900s and to Nazi genocide half a century later.

What is the proof that biological evolution has taken place?

Since then there have been many forms of confirming evidence for evolution and for natural selection as one of its major mechanisms. Aside from the fossil patterns and neighboring regional patterns, other examples of evidence for evolution by natural selection include the following:

* Fruit flies, that reproduce new generations in a few days and are therefore useful for laboratory experiments on breeding, have been made to develop increasing levels of alcohol resistance by the deliberate selection of surviving flies in higher and higher concentrations of alcohol to breed the next generation.

* Antibiotics are known to drive the creation of new varieties or species of drug-resistant bacteria by killing all bacteria except for those that somehow become equipped with a change that renders the antibiotic impotent against them. The development of drug resistance is a major medical problem in the world for treatment of often fatal infectious diseases, such as TB or certain forms of staph.

* Embryos of vastly different species, such as fish and humans, go through similar stages of development, such as arches on either side of the neck that in fish turn into gills and in humans into the jaws, the small bones of the inner ear, and the bones and cartilages involved in speech.

* Limbs and other body parts of various vertebrates (animals with spines) are similar in the numbers and arrangements of bones, such as in fins, arms and legs, and wings (called homology).

* DNA is found in the cells of all living (and extinct) creatures from bacteria to roses to palm trees to ants to mice to pigs to lions to humans.

* Furthermore the amount of difference between the DNA of two different species parallels the amount of difference in their sizes and shapes — in other words, the more one species has evolved away from another the more the DNA has changed, and conversely the closer two species are to each other in size and shape the closer their DNA structures are.

* Successive generations of moths in industrial England, as the soot from factories darkened the trees, turned a darker color for camouflage from birds that eat them, and this change reversed itself in areas where pollution was lessened. (This example actually turns out to be far more

complicated than that and has been the subject of a large amount of experimentation, observation and controversy among biologists over many decades. But most, if not all, of them agree that, while there may be more factors involved in the unquestioned evolution of moth coloration over time, nevertheless all these factors illustrate natural selection at work. Reality has unlimited complexity, and the struggle to understand more and more of the involved factors illustrates the ongoing process of science — which, as we said above, is a method rather than a body of knowledge.)

This is just a small sampling of the various pieces of evidence that take us beyond a reasonable doubt that evolution really takes place, and that not all species were created at the same time. Indeed, if not all members *within* a species are created at the same time — for example, your great grandparents were created before you — why should it be that all species were created at the same time?

There have been many new discoveries that have revolutionized the science of evolution since Darwin's time, things about which he knew nothing but in broad outline may have had some suspicions. For example, he knew that there must be something that was passed from generation to generation through impregnation, since he needed to explain why offspring look much more similar to their parents than to other members of the species or to other species. But he didn't know anything about genes or chromosomes or DNA or the genetic code that translates from DNA to proteins. These were discovered in stages, from the mid 1800s when Darwin wrote to the latter part of the 20th century, a hundred and fifty years later.

Because over the last 150 years there have been so many independent types of confirming evidence for evolution, and more continue to be discovered every day, the fact that all forms of life today have arisen out of earlier forms and were not created at the same time has, for all practical purposes, been proven. In this case, we might add, beyond a reasonable doubt.

How does natural selection work?

So far we have explained the essential features of evolution, and now we will explain the essential features of natural selection. Examples help to illustrate the process. Sickle cell anemia occurs when one gene that is involved in the construction of hemoglobin undergoes a mutation that changes the DNA and hence the structure of the hemoglobin. Hemoglobin is the molecule that occupies our red blood cells and carries oxygen from the lungs to everywhere else in the body. The hemoglobin that results from this particular mutation causes deformity of the red cells into the shape of a sickle (a crescent-shaped instrument used to cut grass and grains) rather than the normal disc shape. The sickle shape hinders the passage of the cells through small blood vessels and causes a painful decrease in oxygen supply to various parts of the body in those people who receive the mutated gene from both parents. Furthermore before treatment was developed, they tended to die young. Those who have the gene from only one parent generally live a full life, and do not sickle to the same degree. They are said to have sickle trait rather than sickle cell disease.

This mutated gene was allowed to spread in various populations where malaria exists because a little bit of sickling prevents malaria from making one sick, for reasons we won't go into here. So people living in areas where malaria is widespread – mainly the eastern Mediterranean, India, and West Africa – and who have one mutated gene from one parent but a healthy one from the other parent will be protected from malaria and will survive long enough to produce children.

In areas free of malaria the mutated gene had no chance to spread in the population because non-sicklers would generally survive to adulthood, and they and their children would be a much larger portion of the population than sicklers, who might die young. But in areas with malaria, death of non-sicklers from malaria allowed the protected sicklers to spread throughout the population. So malaria is a selection pressure that favors sickling. Thus that which is a relative advantage in one environment (sickling in the presence of malaria) is a relative disadvantage in another environment (where malaria is absent). This process in no way suggests intelligent design, but rather illustrates natural selection.

A second example, which is just a hypothesis (educated guess) at this point, requires further research and evidence before it can be accepted as fact. The proposal is called the Slaveship Hypothesis of hypertension (high blood

pressure). Black citizens in the U.S. have higher rates of hypertension than other ethnic groups, in part caused by higher sensitivity to salt intake and retention. To explain this fact it has been suggested that the Middle Passage, in which black African men and women were stolen from their native lands and brought to the Western Hemisphere under unimaginably gruesome conditions in slave ships, constituted selection pressure for those who were able to retain salt and thereby prevent dehydration and death. Those who were less able to retain salt, according to the hypothesis, were much more likely to die on shipboard, leaving those with higher salt retention as survivors who made it to land and into slavery. Their descendants then have, again according to the hypothesis, higher rates of salt retention and consequent hypertension. Whether or not this turns out to be true, only time will tell, but the thinking behind it does illustrate the process of natural selection. It does not take into account much higher levels of stress caused by extreme racism, which also contributes to greater levels of hypertension.

In summary, the essence of natural selection is that those members of the population who have forms of genes that are incompatible with the environment tend to die young and fail to produce children, allowing those with forms of genes that are compatible to increase their proportion of the population. It is important to note that natural selection continues to play a role all the time, including the present.

Thus any particular body configurations or capabilities that are at least in part based on gene differences and that allow the possessors of those body configurations and capabilities to live long enough to breed, or have more offspring for whatever reason, and to live long enough to raise their offspring to childbearing age so that they too may have offspring, will eventually come to predominate in the species in any particular environment that favors those configurations or capabilities. This, however, is still *micro*evolution.

What causes *macro*evolution?

But what causes new species to arise, *macro*evolution? Darwin thought, and it is still a widely accepted explanation among biologists, that if a small number of members of the species were somehow separated from the main group, and in these new surroundings found sufficiently different environmental features, such as different types of available food, they would be under different pressures to evolve in different directions. He assumed that this was the way the various species of finches, mockingbirds, tortoises and lizards on the various Galapagos Islands (separated by tens of miles) developed differently on these different islands.

After enough generations of evolution took place under different environmental conditions, the two groups of what were originally members of the same species would develop enough difference from each other that even if brought back together they could no longer interbreed. Then a new species would have arisen from this small group (so-called founders) that somehow got separated from the main group. Meanwhile the main group, i.e., the ancestral species, might continue to exist even as its descendant species now exists.

Thus while hominids (a succession of various forms of human-like species) evolved from chimps hundreds of thousands of years ago, nevertheless chimps continue to exist as an ancestral species alongside of its descendant species, us, while earlier hominids happen to be extinct.

So the result of this entirely natural process, without any goal and without any mind or being that can summon up a goal, is the emergence of species and features of species that are said to be adapted to the environment that the species finds itself living in. The great height of the giraffe, for example, may be an adaptation to reaching the high leaves on the trees or to seeing lions at a great distance before they are attacked or to some other advantage, in the sense that it developed in response to one or another advantage, over many generations. Then as a result the height is now a characteristic of each member of the species. What happened to the *species* as a whole over time became the property of each *member* of the species.

Looked at from the outside, one can easily imagine that this could also have been attained by a supernatural being with a goal in mind of allowing the giraffe to feed off the high leaves or to detect and avoid lions or to accomplish some other goal. The fallacy in ID thinking is the illusion that, just because one can *imagine* this happening through a supernatural being with a goal in mind, it did in fact happen that way. They, of course, apply it also to much more complex structures than great height, claiming that there are no intermediate steps that they can imagine to account for the final outcome, but the point is the same. But their lack of imagination is not the stuff of which science is made, although it is part of the stuff of which arrogant ignorance is made.

Cleverness in the absence of knowledge leads to dead ends

Science is hard work, years and years of persistent investigation and cooperation with many others investigating the same phenomena. But the scientific method is more than just hard work. There used to be, and may still be for all we know, a shelf in the library at the Harvard College Observatory reserved for what was called crank literature. These were self-published essays (no respectable scientific journal or publisher would print them) by very clever people trying to show how, for example, Einstein's special relativity theory was all wrong.

It's not that these authors weren't clever and not that they didn't do a lot of creative thinking, it's just that they didn't understand the theory they aimed to debunk. The work they failed to do was to study, and come to understand, special relativity theory. So their arguments were aimed at strawpersons. They were debunking a version of the theory that no one would have defended. This, in effect, is what the ID people do when they debunk a false version of evolutionary theory, though it is difficult, without more investigation than is worth the effort, to know when they themselves are just ignorant of it, or when they are simply lying and relying on the fact that most of their audience will be untrained in the theory. Either way the outcome is the same.

The ID attack on evolutionary theory

So what's the fuss coming from the IDers? As outlined in the second section of this pamphlet on the recent history of ID, in at least a temporary concession to their losses both in court and at the ballot box so far, rather than demand that the teaching of evolutionary theory be removed from the schools altogether, they now demand that ID be taught alongside evolutionary theory as an equally valid approach to biology.

The basis of the claim of equal validity is twofold: a) First, IDers claim that evolutionary theory is just that, namely a theory, and not a fact, and b) second, IDers claim that a creationist explanation of how the biological world got to be the way it is today is just as scientific as evolutionary theory. In answering these claims, this section necessarily recaps and summarizes some of the above discussion of evolutionary theory. This may incidentally help the reader to understand it better.

Is it true that evolution is "just" a theory and not a fact?

First, on their claim that evolutionary theory is just that, namely a theory, and not a fact. As we have seen, this is absolutely false and relies on a common misunderstanding on the part of the lay public. There is little in the world that is as completely proven *fact* as evolution, i.e., that all plants, animals (including humans), and fungi have evolved over time out of ancestral forms and are traceable all the way back to bacteria, and even before cells to molecules of varying complexity. The *theory* behind it –called the "theory of evolution" – is not the *statement* that all life has evolved from earlier forms, but rather an *explanation* for how that took place — i.e., the mechanisms of evolution, natural selection along with other processes discovered more recently.

Darwin first cemented the *fact* of evolution and provided the initial form of the *theory*. Since Darwin, voluminous evidence continues to confirm the *fact* of evolution more strongly than ever. As to Darwin's proposed theory, it has undergone tremendous evolution and advancement. This is precisely the way science progresses. Scientific theories are not inert, but rather are continually changing bodies of ideas — changing, of course, through the efforts of scientists working in that particular field, and through new discoveries that these efforts produce.

This change usually does not involve complete rejection of prior forms in favor of newer forms, but on rare occasions it can mean just that. The scientific process usually involves refinement, development, clarification, reinterpretation of meaning, and so on. This continual change is a result of the use of scientific methods for attempting to understand the real world. The real world is the final arbiter, and all theories, whether in physics, chemistry, biology, history, or what have you, are constantly undergoing questioning, extension, and, when found to be necessary, revision, either partial or sometimes complete. The continual questioning of everything is central to the scientific process, even though it is not applied consistently by all scientists all the time. Questioning often leads to controversy, out of which progress can be made.

Questioning and controversy are major *strengths* of the scientific process in all areas, but IDers single out evolutionary theory to exploit the questioning and controversy as though they were weaknesses. They dishonestly jump into every controversy, or as yet unanswered question, to claim that this shows the falseness of evolutionary theory. Nor do they hesitate to declare to the unwary listener that even those questions that have been answered with voluminous evidence are still in the jury room. But as we have seen, one of the things that signifies a stronger scientific theory is the degree to which it generates new questions that require new answers.

Is it true that Creationism or ID is just as scientific as evolutionary theory?

The IDers claim that their explanation of how the biological world got to be the way it is today is just as scientific as evolutionary theory. Unlike within science, questions and challenges to the creationist or ID position rarely if ever come from within, though there are plenty of challenges to it from those in opposition. The creationists' defensive answer to any and all challenges, as with all religious outlooks, is generally very flexible. In general, it takes the form that "God" can do anything, and we cannot know what "God" intended. In this fashion no challenge can conceivably succeed in changing or developing the outlook, which fact alone takes Creationism/ID out of the running for a scientific theory.

Only when some group within the creationist/ID outlook, often centered around some individual, wants for their own power reasons to branch off and form their own outlook, is there controversy. But this kind of controversy is not subjected to the test of reality.

The very lack of questioning or testing from within the outlook leads to a lack of development, refinement, and extension of Creationism and ID. This lack of development is the very antithesis of science. This static position, if nothing else, demonstrates that ID is not, in fact, science and therefore has no place in the science curriculum in the schools. While the concept that "God" created all the creatures, along with the heavens and the earth, in one short period of time, may have resulted from someone's inductive insight way back when, nevertheless it does not produce deductive predictions that can be investigated experimentally or observationally. For this reason, too, there is no conceivable evidence that could either confirm or disconfirm it. This too keeps the outlook from being subject to modification and therefore from being scientific. Creationism is a dead-end concept that offers no basis for its own further development, let alone the further development of the science of biology.

As a result of the emptiness of Creationism and ID, its advocates, rather than advancing their own outlook, spend all their time trying to find fault with evolutionary theory. They are little different from the church during the European renaissance hundreds of years ago whose position of authority was threatened by the discoveries and theories of Galileo and many other scientists and philosophers.

What is ID's major argument against evolution, and what's wrong with it?

The basis of ID is the concept that such well adapted biological features as, for example, the eye couldn't possibly have arisen through accident in a spontaneous way. The eye is too detailed and too perfect for it to have developed without an intentional being with a goal in mind. This was what Reverend Paley (mentioned above) was thinking when in 1802 he likened the eye to a watch. Of course, a watch did develop at the hands of a maker with a goal in mind. Or more precisely, a watch had thousands of makers who developed it piecemeal over many centuries, each with a goal or purpose in mind. But this development was based on a lot of trial and error, with each improvement based on the recognition of a defect in the way it was currently functioning.

This trial and error also happens to parallel the way the mechanism of natural selection works — getting rid of less successful stages in favor of more successful stages when they happen to occur and are genetically inheritable. Less or more successful, that is, in whatever environment, or so-called ecological niche, the population happens to find itself. It is a principle of dialectical thinking that success can never be judged independent of context, since something successful in one environment may be unsuccessful in another, and vice versa.

In contrast to the watch, the eye did not have a developer, or developers, with any goal in mind. However, it did develop in many stages, though IDers claim that it is so perfect that it could not have happened in stages, since, they argue, intermediate stages would not have survived natural selection. This is the "argument from incredulity" (unwillingness to believe). The "argument" goes: since we can't imagine this happening, it must not have.

Darwin himself anticipated this non-argument and answered it in *The Origin of Species*. He showed the way the eye might have developed by examining its various rudimentary stages in a variety of still living species of animals. For example, the eye could easily have begun with light sensitive nervous tissue that was then organized into cells arranged to detect the direction from which the light was coming, and then organized into focusing apparatus that functioned to provide clearer images, and then muscles to control the focusing and the movement of the eye toward different directions. The cells covering the light sensitive cells at some point became transparent to visible light, and so on.

The fact that Darwin anticipated this objection almost 150 years ago is not because he could see that far into the future. Rather his contemporaries were making the same objection. ID therefore, has made no progress whatsoever in the last century and a half, unlike the science of evolution which has evolved tremendously, as discussed above in the section on evolutionary theory.

What's so perfect about the human body?

An additional point is that the eye is not, in fact, as perfect as all that, in either its structure or function. After all, consider the number of people who have to wear glasses for either close or distant vision, the common eventual clouding in the lens (cataracts), the almost inevitable inability to focus as we get older (presbyopia), macular degeneration, and other disorders. Also consider the lump of jelly behind the lens (vitreous) that can function as a cushion for trauma and protect the light-sensitive cells in the back (retina), but does so hardly better than the water that fills the anterior part of the eye, and worse yet, the vitreous commonly gives us annoying floaters and eventually detaches from the retina in almost everyone as we age, with the risk of tearing the retina and even pulling it loose (detachment) with consequent blindness. Of course, people have learned to fix much of this surgically, but then there is no dispute that people apply intelligent, or intentional, design. The dispute is over whether there is a non-human intelligent designer.

Other problems with the eye are, first, that a huge variety of animals – including horses, giraffes and cattle, for example – have eyes on opposite sides of their heads that see in different directions from each other. This means that, while they can see in all directions at the same time and be warned of possible dangers, they have no stereoscopic vision, i.e., no significant capability of depth perception. Humans and many other animals, on the other hand, have stereoscopic vision, because our eyes are in the front of our heads and both eyes can see the same thing at the same time. But we can't see behind us to warn us of silent dangers approaching. A more intelligent design would be that both horses and people possess both capabilities, perhaps requiring a third eye in the backs of our heads.

But even more fundamentally arbitrary is the assumption by IDers of a particular motivation on the part of the intelligent designer. If giraffes, for example, have eyes on either side of their heads and are tall enough to detect lions before they have a chance to sneak up close enough to capture them, in whose interests did the intelligent designer design? Clearly not the lion's in this case. If lions have eyes in front of their heads so that they can judge the distance to the giraffe and sneak up close enough to capture them, the designer did not have the giraffe's interests in mind. Only a natural process in which each of these two species is forced to fend for itself and develop its own characteristics can be part of the development of the giraffe's ability to detect and outrun and the lion's ability to sneak up and capture.

Of course, the IDers will undoubtedly respond that the intelligent designer decided to let each species fend for itself – an example of the infinite flexibility of the outlook to fit whatever objections arise, but which robs it of any explanatory power whatsoever. It also reminds one of the glee with which the ancient Roman slave-owning ruling class threw gladiators into the arena and watched them fight to the death – the opposite of a working-class outlook.

Still other problems with the eye are that human retinas, unlike those of certain other creatures, are sensitive only to a particular range of the electromagnetic spectrum, that portion commonly referred to as "light," but not to x-rays, radio waves or infra-red, for example. Therefore humans are unable to see much in the dark. In fact, the very definition of "dark" is the relative absence only of visible light, but not necessarily of other ranges of the spectrum. However, humans have been able to develop a fix for that weakness in the form of x-ray detectors, radios, or infra-

red goggles (although, as with many capitalist inventions, the latter have been developed primarily for the purpose of killing, i.e., police or military use).

Human bodies in general suffer from similar imperfections. Other examples include our immune systems, which help us to fight off bacteria or viruses or other things that make us sick. The immune system is an extremely complex set of cells and cellular products such as antibodies that do a fair to middling job in many cases, but need help in the form of antibiotics in a lot of cases. On the other hand, the immune system can also be our enemy. There are many diseases in which our immune systems attack us instead of the bacteria/viruses. Allergies are the most common example, and they can range from bothersome to extremely serious. There are also autoimmune diseases such as rheumatoid arthritis that can cripple and cause severe pain and dysfunction. Also the main reason we treat strep throat with antibiotics is to prevent the development of antibodies to the strep that also attack certain cells in our own kidneys.

Cancer is yet another example in which our bodies attack us. All cancers have in common that some of our own cells either lose or block those molecular mechanisms that keep their multiplication in check. Instead the cells grow wild, eventually taking over some of our vital organs, preventing them from functioning properly and eventually resulting in our deaths.

The heart is subject to arrhythmias, vertebral discs to oozing into the spinal canal and squeezing on nerves with excruciating pain and immobilization, hips and knees to degeneration requiring replacement, and so on. And there are hundreds of other examples that could be given of the imperfections of our bodies.

How intelligent is the supposed "intelligent designer"?

Furthermore why is it that an "intelligent designer" didn't give us natural watches or clocks? We have only the crudest timekeeping response to the 24-hour day, which mainly involves the pineal gland in the back of our brains. Why did we have to fill the need for accurate and precise timekeeping through our own inventions and improvements? It would seem that if there were an intelligent designer of the eye, of the immune system, of the timekeeping organ, either she/he/it would definitely be an underachiever (to borrow from Woody Allen) or she/he/it has some mischievous goal in mind for us. Either way, this is hardly the work of a benevolent and intelligent creator.

The concept of goal or purpose arises from universal human experience, in which all humans, and no doubt certain other animals to some extent (a subject of extensive research), have the experience of deciding we want to bring about some change in our surroundings, or even in ourselves, and then setting out to make it happen. The ability to have a goal or purpose is peculiar to humans (and, again, certain other animals), but not to trees or snails or mountains.

Goal/purpose acts in an interesting way, in which, as Marx said, we are capable of erecting a building first in our imaginations and then in fact. In this way our imagining the building is the beginning of the process, while the building that we imagine is at the end of the process toward which we strive. In a sense this reverses the natural order in which things happen, with the final product existing at the beginning of the process (in our imaginations) and the starting (imagined) building existing at the end in reality. In this way, the imagined building is one of the contributing causes of the actual building's development, as contributing causes always precede their effects.

Much of what humans do is based on a decision of what outcome we desire. But extrapolating this ability to some type of non-natural being doesn't necessarily make it so. There are many ideas we can extend beyond their real limits that are not necessarily possible in fact. We can, after all, imagine that we can fly without airplanes. The attribution of goal or purpose to nature is called teleology. Teleology is the concept that things happen *because* of some outcome, which reverses cause and effect. The first syllable, "tel-," means "end" in Greek.

IDers advance many other arguments against evolution, but they all amount to the same thing. In particular, they are all based on a profound ignorance of evolutionary theory and the overwhelming observational and experimental evidence for it. Rather than take up more space here, we refer the reader to a book that answers hundreds of such arguments in detail (Isaak).

The enemies of science within the fields of science

The erroneous outlook that characterizes ID has its counterparts *within* the fields called science, particularly in biology. It is not simply ID that attributes goal/purpose to some unnamed being; much science writing suffers from a similar defect. The main difference is that ID looks to an outside source of power ("God"), while certain scientists (lots of them) look to internal sources (DNA). This is particularly true of the field of Sociobiology (SB), which is now called Evolutionary Psychology (EP), a name switch brought about for much the same reason as the switch from Creationism to Intelligent Design – namely, to evade their critics.

Advocates of SB and EP maintain that complex behaviors have been "programmed" into our genes through natural selection over hundreds of thousands of years. These include, they claim, such complex behaviors as rape, aggression, fear of snakes and aversion to incest. They are sometimes called "nativists" because of their claims for in*nate*ness of these behaviors in infants at birth. The essential feature of nativist concepts is that the relationship between genes and the rest of the organism that possesses the genes is a one-way street. That is, the genes direct the rest of the organism's development and behavior, but, according to them, the organism and its experiences have no effect on the genes—or at least no effect once tens of thousands of years have "programmed" the genes. By adhering to dialectical principles we are reminded to avoid such errors of one-way thinking, and to regard the one-wayness alone as sufficient to render any conclusions derived from it false.

As we said above, the concept of a "God" who works in mysterious ways, and whose motivations are hidden from us, is an infinitely flexible way to answer any question as to why such horrors as slavery or genocide occur. The assumption by nativists that natural selection has programmed complex behaviors into our genes is likewise infinitely flexible. It yields plausible sounding answers to questions as to why people do certain things. But the nativists do not regard it as their responsibility to find evidence that these complex behaviors are indeed determined or directed by our genes. Furthermore they use the counter-scientific tool of unconstrained assumption, without searching for, or even granting that there could be, alternative explanations. Thus they get failing grades on both the deduction and induction fronts (Buller, Blumberg).

The outlook of these nativists (within science) and that of the creationists/IDers (outside of science) are more alike than different. True, the nativists will ridicule the IDers to demonstrate their intellectual superiority, but they fail to see how similar they are to the targets of their ridicule. Some of them also have a tendency to ridicule their scientific opponents, the scientists who do respect the need to supply evidence and who do respect the need to evaluate alternative explanations before they can settle on one over another. But while nativists have much in common with IDers, since they labor within the field of science they are even more dangerous than the IDers. After all, as we discussed above, millions of voters have thrown the IDers and creationists out of office. But unfortunately most scientists are willing to treat the nativists as though they deserve the time of day. So just as we are forced to debunk the IDers, we cannot ignore the nativists.

(See the Summer 2007 issue of PLP's THE COMMUNIST MAGAZINE for reviews of books by and about nativists.)

Religion and science

Scientists and religion

Many, though not all, professional scientists are religious. Many believe in a "God." Many attend church or synagogue or mosque. They, like everyone else who is religious to some degree, look to "God" and to religion for comfort, guidance in their social lives, meaning in their lives, and so on. This is particularly true at times of personal tragedy, such as the loss of a family member or severe illness or danger. All of these are important human needs, and religion sometimes appears to be the best way to satisfy those needs, whether for professional scientists or not.

However, religion is not the only way to fill those needs. In particular, communists and many workers and their allies today look to friends, family, and other class allies for comfort and for guidance, rather than to their minister, rabbi, imam, or "God." Indeed, religionists often look to these sources as well. And to find meaning in one's life

there is nothing more meaningful than devoting one's life to the liberation of the working class from wage slavery and its attendant atrocities, for the sake of present and future generations.

And even more important, religion does not eliminate poverty, unemployment, drug addiction, racism, wars, or prevent levees from breaking or bridges from collapsing. If anything religion only makes these avoidable horrors more acceptable.

It is important to distinguish between the concept of "God" and the organized institution of religion. They are separable entities. After all, some religions have no concept of "God," such as Buddhism, Jainism or Sikhism. Some worship one "God," such as Judaism, Christianity, Islam and Zoroastrianism. And still others have multiple "Gods," such as Shintoism and ancient Egyptian, Greek and Roman religions. Conversely the concept of "God" arose prior to the organization of religion. Later it was simply adapted by some organizers of religion for their own needs.

When early nomadic hunters and gatherers, and later sedentary agriculturalists, sought explanations of patterns they noticed in nature, such as day and night and the seasons, the idea came easily that there was something or someone out there orchestrating these things. After all, they were able to organize things into patterns themselves, so it was not much of an extrapolation. But this concept of an unseen being preceded organized religion.

In fact, the hypothesis of a supreme being may be regarded as one of the earliest forms of science. After all, at least they were asking the question, How did this come about? And asking the questions, as we said above, is 90% of the battle in science.

Agnosticism versus "atheism"

Scientists who believe in "God," like other people, have various interpretations of what "God" is. But the concept comes down to some non-natural or supernatural entity. When those who practice the scientific method from 9 to 5, so to speak, believe that there is a "God" or at least consider themselves to be agnostic (i.e., don't know whether there is or not), they are either being inconsistent or they are at least unnecessarily limiting the domain of applicability of the scientific method. Consistency certainly plays a major role in science, as the discovery of inconsistency drives many a questioning and revision in science.

Still other scientists and many other people, including many communists, believe in the non-existence of "God" and consider themselves "atheists" (we will explain the reason for these quotation marks momentarily). A common justification for agnosticism, as opposed to "atheism," is the statement that while there is no scientific proof of "God's" existence, neither is there proof of "God's" non-existence. So some scientists, as well as others, believe themselves to be agnostic and don't take a position, leaving it to others. This only reflects the lack of a thoroughgoing adherence to scientific method.

The problem here is not only that there is an absence of proof that "God" exists, but *there isn't any scientific reason to believe in that existence*. In other words, the burden of proof, from a scientific point of view, should not be on those who doubt or deny the existence of "God," but rather on those who believe in "God's" existence. The reason that the burden is, in fact, placed on "atheists" is that the power of organized religion, backed by the political and economic power of the ruling classes throughout the ages, gives them the ability to decide where that burden is to be placed.

This brings us to the reason we put "atheism" in quotes. The very word is forced on us by the power of organized religion (backed by the political and economic power of the ruling class). That is, *a*-theism, meaning *not* theism, defines the position that there is no "God" in terms of what it is *not*, namely not theist, not "God"-believing. It would be more scientifically valid and consistent to term the belief that there is no "God" something like "naturalism" and use the term "*a*-naturalism" for the belief that there *is* a "God." In today's world that might seem like the tail wagging the dog, but the class power relationships will not always be the way they are today under exploitative class society. And in any case it is scientifically more justifiable terminology.

The Bible and its inconsistencies

As to the reasons to doubt the Bible's account of history, consider how it came to be. The concept that it was through the leaders of organized religion getting a direct communication from "God," i.e., divine revelation to the self-anointed few, comes from precisely those self-anointed few. Why should anyone believe them? In fact, until the printing press was brought to Europe in the 1400s from China (where it was invented several hundred years earlier), regardless of how the Bible was first written, each time it was copied it was hand written by monks and other clerical personnel.

Furthermore it was only translated into English for the first time in the late 1300s. It was previously only in Greek, Hebrew, and Latin. Over the next two centuries numerous other versions finally culminated in the still popular King James version in the 1600s. Each time it was copied or translated, as in the game of telephone, it was amended to accord with the biases of the copier, translator, or in the case of the King James Bible the sponsor. As various Protestant groupings split from the Catholic Church and from one another, over and over, these biases reflected the self-interests of new competing sets of self-appointed religious leaders. After countless rounds of such copying and retranslations from the ancient languages, it is no wonder that the various versions contradict each other.

Without going into the hundreds of thousands of examples of inconsistencies in one or another version of the Bible (see, for example, Isaak, p. 211), suffice it to say that there is no reason to take anything it says as "gospel." In fact, the Gospels of Matthew, Mark, Luke and John in the New Testament, which all purport to describe the crucifixion of Jesus, contradict each other perversely in many details. It is ironic that the word "gospel" therefore has come to stand for "truth." There can only be one truth, given the existence of a real world, even if there can be as many, and perhaps more, different feelings about or interpretations of events as there are interpreters. From these various interpretations we struggle with each other and with the real world to come closer and closer to the truth about the real world, but only if we have a materialist approach.

And the many versions of the Bible represents the Judeo-Christian religions but not the huge numbers of religions outside the centers of Europe and the U.S. Religion divides the world into factions that are led by their masters to kill each other for the gain of the masters. "God-Jehovah-Allah" is on our side, say both the opposite parties to a war. Science, on the other hand, is an international effort, constructed and organized as a way of arriving at internationally accepted theories of everything from atoms to galaxies, from biology to geology. However, science under capitalism suffers from severe and detrimental aspects of competition (consider the Nobel Prize, for example), even if competition sometimes speeds up the process, as well as limitations on what research is promoted, or even allowed. More often than not, competition drives scientists, in their haste to publish or in their need for a job with job security, into blind alleys. In contrast, in science, as in all human endeavors, there are also tremendous elements of cooperation.

Capitalists, who as a class rule the world today, thrive on domestic and international competition, while the working class, who are about to rule the world tomorrow, thrive on international cooperation. Under communism, science will no longer need to involve competition. Cooperation will then rule the day. This will make possible much greater progress in all areas. Then the pressures driving the process forward will be the needs of humanity yet to be satisfied – the relief from poverty, illness, hunger and danger.

The role of proof in agnosticism

Agnostics demand absolute proof that there isn't a "God" in the real world apart from the concept in the minds of humans. We have discussed the nature of proof above under the topic heading "How are evidence and proof related?" in the section "What is science?" In particular, we pointed out that there is no such thing as absolute proof, but only proof for all practical purposes. There is no absolute proof that ice can never catch fire, or that the sun will not continue to rise tomorrow for at least the next several billion years, but no scientist, and very few others, would claim agnosticism based on that lack of proof. Rather they would firmly deny that it could happen.

What then is the source of this sudden invoking of agnosticism when it comes to the non-existence of "God"? It is the overwhelming peer pressure within modern societies around the world and the millennia of organized religion that create the illusion that there may be a reason to believe in the existence of "God." We have been putting the word "God" in quotes for two reasons: 1) because there are vast numbers of concepts of "God," and no one single concept to which the word refers, and 2) because the *concept* of "God" exists without a "God" in the real world.

Among the more famous modern scientists who believed in some concept of "God" was Einstein. In objecting to the prevalent interpretation of quantum mechanics, namely that nature is at root probabilistic and has no definite characteristics, he famously retorted, "I don't believe God plays dice with the universe." Was he being metaphorical or literal? Apparently literal, since he also said that he believed in some kind of a Supreme Being that created the universe, but that he had no idea what the Supreme Being was like otherwise.

Those scientists who maintain that the only really scientific approach to the question of "God" is agnosticism justify that position on the grounds that there is no proof either way. However, they are attributing to the concept of proof in this instance a quality that they never demand of it in other areas of life – absoluteness. As we have discussed, proof is never absolute, but rather it has the quality of being acceptable for all practical purposes.

The comedian George Carlin puts it in a lighter vein. He explains that he was doing a controlled experiment to see if "God" answers prayer. So he first prayed to "God" and then he prayed to Joe Pesci. He found that the results were "about the same." Even comedians can be scientists, and vice versa.

Of course, prayer can give psychological comfort to the one who prays if she/he believes in "God," but it cannot play a causal role in bringing about a desired outcome, except perhaps through strengthening one's resolve to *act* to bring it about. Whenever the desired outcome does in fact arise independent of the actions of the one who prays, the relationship between prayer and outcome is coincidental. Coincidences, after all, are not only all around us, but they are the things that we tend to notice. We often fail to notice those much more common occasions when the desired outcome fails to arise. This common phenomenon is known as selective perception.

The source of a claim and the content of a claim

In addition, even before the issue of proof arises, in order to be accepted, a concept must be reasonable. For example, just because someone maintains that a flying saucer landed in her/his cornfield, and she/he can produce several witnesses to confirm it, doesn't mean we have to believe it. More fundamentally, it doesn't mean that it is true. The best way to approach reasonableness is from two directions, namely is it a reasonable claim and, if not, can we find a cause for someone to make such a statement?

If we feel that the claim is reasonable we might demand evidence, though as we have pointed out, particular pieces of evidence are confirmation but there may not be enough evidence to constitute proof (for all practical purposes). The less reasonable a claim is, the more independent types of evidence we may demand before we consider that there is enough evidence to constitute proof. Conversely, the more reasonable a claim is, the fewer types of evidence we demand as proof.

If we feel that a claim is not reasonable, can we provide an explanation of why the claim might have been made in the first place and of why so many witnesses were willing to confirm it? The farmer who saw the flying saucer might have misinterpreted certain natural phenomena, such as the breaking up of light from the setting moon by mountains on the horizon and airwaves that caused flashing in different colors, interpreted as lights on a space ship. This might also explain why so many witnesses confirmed it. Or the farmer may be a liar or a publicity seeker, with the witnesses having been paid off. Either hypothesis, of course, requires evidence. Sufficiently persistent investigation into these speculations should produce a way to tell which is correct.

Can "fifty million Frenchpersons" be wrong?

There is an expression, "Fifty million Frenchmen can't be wrong," that comes from a musical of the 1920s by the songwriter Cole Porter. It means that if a large enough number of people believe something, it must be true. But if they all derive their belief from the same source, and the source is unreliable, they can indeed all be wrong – all fifty million of them.

There is a famous fallacy in logic called the fable of the Emperor of China. Could one determine to a high degree of accuracy the height of the Chinese Emperor by asking every one of his millions of subjects how tall he is? This would certainly constitute a tremendous number of pieces of evidence. But the fallacy is that these pieces of evidence are not independent types, or even independent from each other within the type, since an impression of the Emperor's height would likely be part of the popular culture, even for those who never laid eyes on him. So the

number of pieces of evidence is then irrelevant. Besides, there is no necessary connection between how tall people who have never seen him think he is and how tall he actually is. This introduces an error in the estimates that is undeterminable, without comparing them to the Emperor's actual height. In that case, however, who would need the opinion of the millions of people?

An explanation for why so many people believe that an all-powerful, benevolent "God" exists outside of the collective minds can only be found in the study of the history of religions and "God" worship. It is precisely this history that the creationists demand not be questioned or studied. And with good reason, because in that history might be found the explanation of why so many people believe in "God" even if "God" doesn't exist in the real world. Of course, a concept of a "God" does indeed exist in the minds of millions of people, now and throughout much of history, and as a result in many cultures, but that does not mean that "God" exists outside of those minds and cultures, i.e., in the real world.

The history of religion is the history of a powerful priestly class

We have to study the history of religion to learn why it is that so many people believe in a "God" for which there is no evidence outside of the minds of people, and outside the statements that these minds produce. When we do so, we find that religions, including the concept of "God," are always organized by a class of clerical persons who assert their power over the vast majority of humanity as the main, if not only, links between people and "God." Indeed the original translators of the Bible into English were opposed and sometimes burned at the stake by kings, queens, and popes, who wanted to keep complete control of the "Word of God" and conceal the hidden reality from the masses of common people (Bobrick).

The recent scandals over sexual abuse of children by members of the Catholic clergy reach into various orders, such as the Franciscans, Carmelites, and Jesuits, and are resulting in hundreds of multimillion-dollar out-of-court settlements. It is not just the higher-ups in the various religious hierarchies, or the early creators of the various religious orders, who have been aware of their power over their millions of followers. Even thousands of individual members of the clergy are aware of this power and often bend it to their own use, in what almost everyone would agree are ghastly criminal pursuits.

Once we understand that the concept of "God" has always been a tool in the hands of the priestly class that arose when class societies arose, a tool to wield power over the rest of the population and attain great wealth thereby, we realize that, other than millennia of overwhelming peer pressure, there is no reason to believe that there is a "God" outside the mind (Blech). Then the only scientifically consistent position is the belief that there is not a "God" outside the minds of people. That is, the only scientifically consistent position is naturalism (so-called "atheism"), rather than agnosticism.

In the battle between science and religion it is important to remember that battles are not fought by ideas, but rather by people holding those ideas, or more accurately in today's world, by social and economic classes. Behind every great battle of ideas is class interest. The capitalists have a stake in one set of ideas and the working class in another set. Changing the real world from capitalism to communism is in the interest of the working class and against the interest of the ruling class. It may take some searching to find under the table the class whose interests any particular idea serves – in particular, to find the connection between that particular idea and the need to change or keep the world as it is – but with enough effort it can be found.

Religion, all religion, and the belief in "God" are ideas pushed by the capitalists to protect their class power by blinding the working class to our need to be strictly scientific in our approach to managing the problems we have as workers and in changing the world to a communist egalitarian society that will serve the interests, for a change, of the working class and not our exploitative and oppressive enemies, the capitalists.

Within religion there are some progressive aspects, but not enough to count

An apparent exception can be found, for example, in liberation theology. Liberation theology is a development in the Catholic church in Latin America, involving priests who side with the working class against the capitalists, but at the same time do so to counter the influence of Marxist revolutionaries. Two famous 20th century examples, out of many, are Oscar Romero, the Archbishop of El Salvador, and Dom Helder Camara, a Bishop in Brazil. Archbishop

Romero was assassinated in 1980 by the Salvadoran ruling class for his advocacy on behalf of the poor working class. Bishop Camara is noted for having said, "When I gave food to the poor, they called me a saint. When I asked why people are poor, they called me a communist."

Coming from the Brazilian ruling class, this was not, of course, intended as a compliment, nor did Bishop Camara consider it as a compliment, though we would regard it as one. However, it was an undeserved compliment. This illustrates the constraints inherent in religion, since Bishop Camara, as admirable as his advocacy for the poor working class may have seemed, not only had no solution within the confines of religion for our oppression as a class but actually stood opposed to any revolutionary attempts to organize the working class to solve our own problems.

The only possible solution is the transference of political and economic power from the oppressive capitalists to the liberated working class. And the only possible agency of that transference is the working class itself, led and organized by communists to see the need for communism and motivated with the readiness to fight a collective armed struggle to bring it about. The ideological bonds of religion and the illusion that, under such clergymen as Archbishop Romero and Bishop Camara, the church can alleviate the suffering of the working class, both serve as major obstacles to liberation from that suffering. Unless a well-meaning clergyman/woman leaves the church, denounces its harmful restraining effects and joins the working class in organizing and carrying out a revolution for communism, that clergyman/woman, in fact though not necessarily in intent, is an enemy of the working class.

Indeed, many PLP comrades work in church groups on reform issues that other members of the congregation, and occasionally the clergyman/woman, are willing to struggle around, such as the fight against racism or to end the U.S. terrorist war on Iraq. But in so doing the comrades always strive to win the others to see the need to join PLP and fight for communist revolution, as the only way that can succeed in winning and holding even the reforms that they all want to bring about.

To change the world the working class needs science, not religion

As to the relative validity of science and religion for understanding the real world and how to change it, religion consists of a body of ideas, while science consists of a body of ideas along with a method of confirming their truth, and changing those ideas when necessary. The one that will serve better to change the world and help us to escape poverty, war, racism, sexism and genocide is science. The one that will serve better to handicap us in changing the world and to tie us to the present state of affairs is religion.

Communists strive to convince the working class of the enslaving quality of religion and to overthrow its ideological hold, as it hampers the development of the revolutionary movement. However, understanding that ideas that have been systematically instilled for millennia will not disappear in hours, communists also struggle patiently first to win workers to join in building a revolutionary movement, maintaining their religious ideas if they must, but attempting to show each step of the way how battles with the ruling class might have been strengthened were it not for the chains of religion.

Communists strive to *persuade* workers that religion is our enemy, not to *outlaw* religion. The capitalists lie when they claim that the Soviet Union, where the working class had seized political power, outlawed religious ideas. Once a revolution for communism has succeeded in breaking the iron grip of the capitalists on the world, it will certainly come to pass that those attempting to regain power will again try to push religion as one of their weapons. That organized attempt will most certainly be outlawed, but this does not mean that religious ideas will, or even could, be outlawed.

The working class must defeat this attack on science

As we said in the opening sentences of this pamphlet, the most important function of science for the international working class is that, without understanding and grasping science, we cannot hope to achieve our liberation from the atrocities of capitalism. This pamphlet was written therefore not just to answer questions about ID and about science, though we have tried to do that in brief outline as best we can in such a limited space. It was mainly written as part of the struggle by PLP to convince members of the working class, students and soldiers of the need to destroy

capitalism with armed revolution and to institute the egalitarian system of communism in its place, and, to begin with, to convince workers, students and soldiers of the need to join the PLP to help lead that revolution.

We hope we have begun to convince the reader that science is a tool that can be seized by the working class for the making of this revolution, and for making and keeping the world livable once the revolution has put the workers and our allies in the driver's seat. The capitalist class and other exploiting classes before them have appropriated the means and ideas of science for the purpose of extending their profits and for the purpose of maintaining their violent control over the rest of humanity. But then the capitalists appropriate (steal) everything that workers produce.

Creationism, Intelligent Design and all religion, fundamentalist or not, is a tool in the hands of the capitalists for our continued exploitation and oppression. Because of this, the working class has an absolute need to resoundingly defeat them and their ideological hold over us. This means, in the first instance, that each of us needs to come to understand at least the elements of science and how it works, and to begin to put it to conscious and collective use for the purpose of organizing the revolution. We have a responsibility to our families, friends and class to master the elements of science, even if at first we don't need to understand relativity theory or quantum mechanics in all their gory details, or even all the ins and outs of evolutionary theory.

However, it is more important for us to understand evolutionary theory than to understand relativity theory or quantum mechanics, because evolution is about change, and change is about revolution. Relativity theory and quantum mechanics can wait awhile. Some day, after the working class controls the schools and every institution in the world, the understanding of relativity theory and quantum mechanics can also become the property of everyone. This will, incidentally, bring that much closer the day that these theories will be replaced with even more accurate theories. Once the mental chains of capitalist ideology begin to wash away, we will all be able to achieve the understanding of any complex theoretical material with fewer and fewer of the burdens produced by false assumptions that creep into everything we try to learn. Then there will be many more of us to investigate how nature and society work, and to develop more and more accurate theories to explain them, as well as to change them.

There is no short cut to liberation. To paraphrase Mao Zedong, a past leader of the Chinese Communist Party, revolution is no tea party. Neither is the struggle to understand what science is and how it works. But all it needs is the motivation provided by a vision of a new world, one free of racism, sexism, exploitation, war and genocide. It is the striving for such a world that can give life meaning, without the need for religion to supply an imagined satisfaction of that very human need.

The only way to defeat ID and all other enslaving capitalist ideology is in the course of the struggle for communist revolution, and in its ultimate achievement all around the world. Join us in this monumental effort now. We have a world to win, and to understand.

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