

From 1973 Chinese Scientific Journal:

# Matter Is Infinitely Divisible

—by Bian Sizu

A proton gets "smashed" into energy neutrino, being  
(See key at bottom of page)

Recently an important collection of scientific articles from Mao's revolutionary forces in China has come to our attention. These articles were published in ten (and possibly more) volumes of a Shanghai journal, *Dialectics of Nature*, from 1973 through the end of 1975. To our knowledge, they have not been published anywhere in English, even though they speak to some of today's most pressing scientific and philosophical questions. For this reason we are asking for people to contact us to assist in translating more of these articles for publication not only in this newspaper, but in other forms as well—getting these articles into various arenas where they should be seen.

Some of the topics covered in other articles include: "On Necessity and Contingency in Mutation", "Motion is not Eliminateable—Commentary on Black Hole Theory", "Cancer is Knowable, Cancer is Curable", "Practice Raises our Understanding of the Brain's Function", "Critique of Einstein's World Outlook", "Can Physiology Give One Intelligence?" "On the Conservation and non-Conservation of Motion—also comment on the 1st and 2nd laws of thermodynamics", "The Internal Factor and the External Factor in the Evolution of Living Things". These are just a few of the titles from the tables of contents.

*Dialectics of Nature* was mainly a journal for the broad popularization of scientific knowledge and scientific outlook among the Chinese people. It also contained theoretical work on the most up-to-date scientific questions. Linking science with the masses and putting it at the service of the laboring people was a revolutionary principle in China. This was not only a question of spreading scientific knowledge, but an important question of the class struggle within China. There was a serious struggle to break the monopoly of the exploiting classes on the leadership and the outlook guiding science, which was being used by these class forces as capital in contending with the pro-

letariat for overall leadership in society. There was also a question of breaking down superstition and unleashing the role of the masses as the main force in scientific experiment. Beyond combating the idea of science as private capital, the revolutionaries also struggled within scientific circles against metaphysics and idealism and for dialectical materialism to play a guiding role, leading scientists to break new barriers and make further advances in scientific theory.

These documents, along with other, more technical ones, need to be rescued from the bin the current leadership in China has dumped them in in their attack on the achievements of the Cultural Revolution.

The paragraph immediately below was an abstract preceding the original *Dialectics of Nature* article. All footnotes were in the original text except those indicated by "translators note".

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This article mainly talks about the fact that material structure in its micro-aspect is infinite. Looking at the structural levels of matter, there is qualitative difference between each level. Going deeper through such levels, it is again an infinite, continuously divisible process. Judging from the concrete structural types of matter, there is the discrete form of matter and also the object form of field, and each level is the unity of these two forms. Judging from the structural characteristics expressed by matter in motion, wavicles (generally called "elementary particles") are expressed both as discrete particles and as continuous waves. Therefore, matter is always one divides into two, it is always the unity of the discrete and the continuous. There is no end to man's understanding of the structure of matter, neither is there an end to the development of science.

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## Matter Is Infinitely Divisible

by Bian Sizu

(Appeared in *Dialectics of Nature* magazine No. 2, Nov. 1973)

Human understanding of nature is, on the one hand, advancing continuously from the immediate to the far-reaching, expanding into broader categories, and marching into the broadness of nature; on the other hand, it is continuously advancing from shallowness to depth, more and more reaching into the ever deeper levels of material structures, and marching into the depth of nature.

The history of the development of natural science is a record of man's triumphant march into the depth and broadness of nature. Human beings initially saw only different things. Later, man reduced various different things to several million kinds of compounds, and these compounds were in turn found to consist of the atoms of tens, hundreds of chemical elements. After further advancing deeper into the structure of atoms, man also understood that all these many atoms are composed of protons, neutrons and electrons—the most important so-called "elementary" particles. With science's further development, not only does the number of "elementary" particles continuously increase to several dozen, but also it is increasingly demonstrated that an "elementary" particle is not elementary and can be further divided. This name itself is very unscientific. At this point we know these particles not only as particles, but also as waves. Some people simply call them "wavicles" which ac-

tually reflects the key characteristic of these micro-objects.

### Discreteness and Continuity

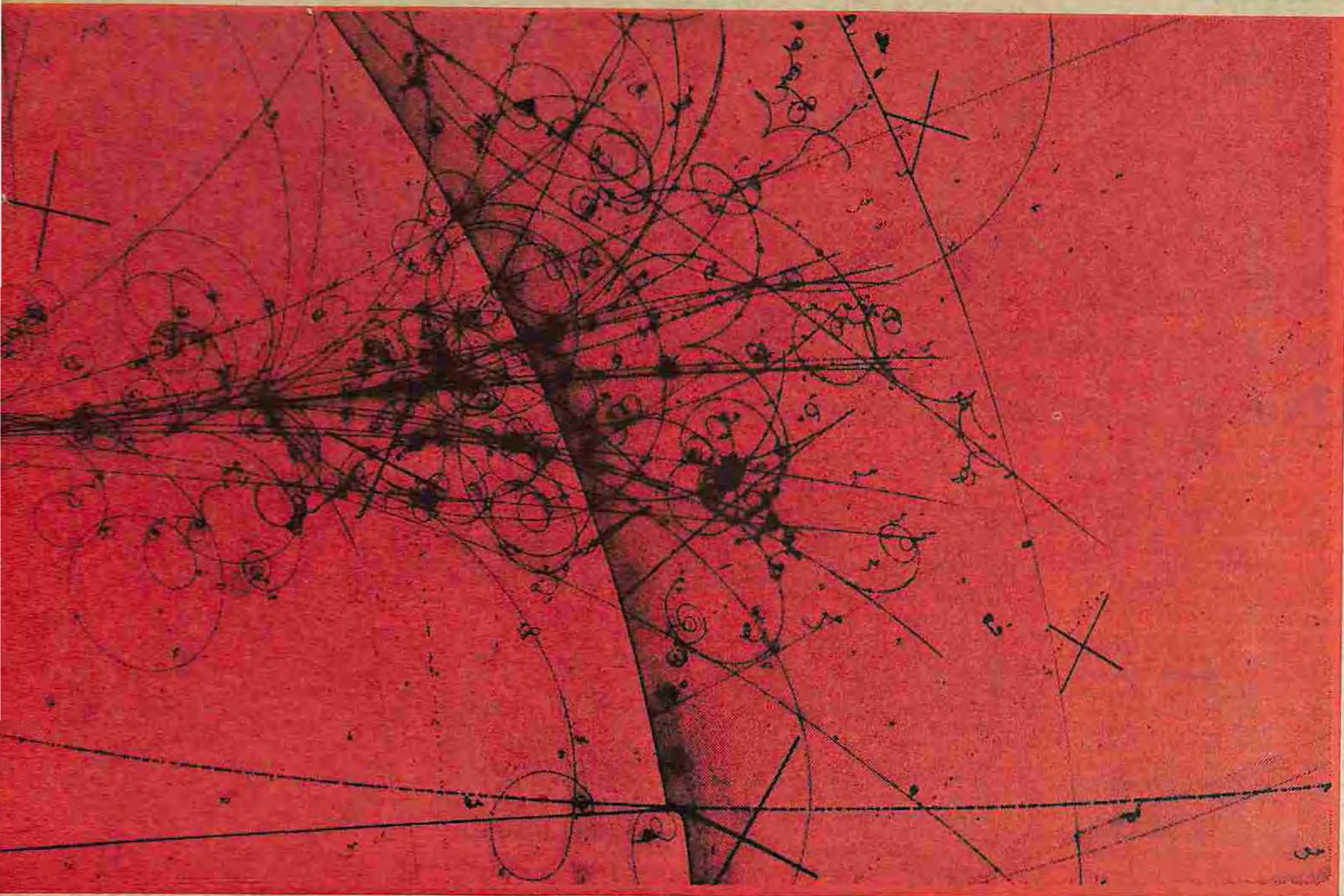
There are various types of things in the world—celestial bodies and dust, mountains and oceans, organic beings and "dead things". Behind these varieties of things, is there some common thing? Is there a unity within this infinite diversity of things? This question pushes man to advance step by step into the essence of things through various stripes and colors of superficial phenomena. As Engels has said, "Here, therefore, is already the whole original spontaneous materialism which at its beginning quite naturally regards the unity of the infinite diversity of natural phenomena as a matter of course". (Engels, *Dialectics of Nature*, Progress Publishers p. 186).

The diversity of the material world can only have unity in matter. Things have a myriad of differences, but they are all matter. However, in ancient times, due to the low level of production practice, men were still not able to abstract the concept of "matter" out of its various concrete material forms. They inevitably "sought [this unity] in something definitely corporeal, a particular thing." (*Dialectics of Nature*, p. 186). They always sought to find a thing "That of which all things consist, from which they first emerge and into which they are ultimately resolved." What is this "element and principle of all being"?

Initially some people conjectured that it is a kind of absolutely continuous matter. In ancient Greece, Thales declared that water is the basis

1. Wavicle refers to micro-particles one level below the atom. For example, the electron, photon, proton, neutron, etc. They are generally called "elementary particles," meaning the smallest particles that cannot be further divided, and this name is rather unscientific, because the out-

standing characteristic of these particles is that in motion they express themselves both as particles and as waves. Therefore, some people call them "wavicles" (combining two words: wave and particle). This article adopts this name.



1." This picture shows a proton, hit by a high energy, which identifies some of the particle tracks.)

While the particles themselves are not visible in this picture, their motion is recorded in trails of bubbles, which form in superheated hydrogen along the path of a charged particle.

of all things. Anaximenes took air as the principal and basic element. In the *Warring States* period<sup>2</sup> of our country, the author of *Guanzi* also thought that water is the "blood and air of earth"; Yang Quan of the *Three Kingdoms* period<sup>3</sup> thought that "water is what builds heaven and earth". And still more materialists in our ancient times thought rather this material is air. They inherited the thesis of Sung Xing and Yi Wen in the *Spring and Autumn* period<sup>4</sup> that air was "the essence of matter"; they thought that heaven and earth were "Nature constituted by air", that air was the "essential substance" of the universe, and all things were the "objective forms" (accumulated, dissipated, and changed) taken by a single essential substance—air.

They sought to find the oneness among manyness in the material world, i.e., the expression of the unity of matter. This was materialism. Unlike [dis-jointed solid] objects, these fluids such as water, fire and air were all continuous. "Flowing water without interruption". It could be measured by volume (as in a container), or it could be divided into drops and iotas in a seemingly infinitely divisible way. As Han Fei<sup>5</sup> said, "Any thing with a form can be easily tailored and divided". Why? "If it has form, then it has length. If it has length, then it has size." For example, a one-foot-long stick. If we cut away half of it today, and tomorrow another half of the remaining half, then we can go on in this way for 10,000 years, still without exhausting the full length of one foot.

Matter is indeed infinitely divisible. Ancient men utilized some concrete forms of matter to express their thinking on the infinite divisibility of matter, thereby objectively expressing dialectics. But to reduce everything into one certain concrete form of matter is to over-simplify the question. Whether water or air, if it is divided in this way, then water still remains water, and air remains air. There exists only the partition in quantity and no change in quality. Engels called it "abstract divisibility, bad infinity" (*Dialectics of Nature*, p. 203). This kind of "infinite divisibility" is completely formal, deceiving, and in essence is not divisibility at all. If everything consisted of this universal plasma, then how could there be diversity in the universe? Such a "unity" becomes one-sided; it only recognizes the unity and abolishes the diversity, and hence it turns into its opposite.

Following the road of this abstract divisibility, one will land in relativism and sophism: The macrocosm (big world) is like this; the microcosm (small world) is also like this. The small world is only the reduced image of the big world. Back in ancient Greece, there were some people who imagined that each particle was also like our entire world: There exist inhabited cities, plowed fields, and there are sun, moon, and stars. You say your world is big, but residents of a small world won't feel their own world is small either. Therefore, there is no difference between the big and the small. "The whole earth is no bigger than the tip of a hair; and Mount Tai is small" (*Zhangzi*<sup>6</sup>). A needle point is as big as the whole world. "Within a pore of Buddha's skin, there exist all the Buddhas, all the places, all the time, and all the benefits" (Buddhist Teaching). A pore is as big as the whole world. The big is also small, the small is also big, and there is no objective standard of things. They become unfathomable things.

Moreover, the argument that the whole world is nothing but a kind of "elementary matter" also opens the back door for idealism. Since this "elementary matter" is so all-capable, it is no longer ordinary matter. It must become a special thing, above matter, a thing above nature. Aristotle called it "ether", or a supernatural thing, a thing above nature, specially made by god. The Confucians, in our country, sometimes also took the "air" that materialists were talking about, and transformed it into something mysterious, beyond matter—"Great Air"—a universal *spiritual* substance. They either preached that the world was united in the inseparable God, or in "Heavenly Will".

Some materialists opposed this thesis of absolute continuity. You say that a foot-long stick can be divided infinitely, but after being divided into sawdust, it obviously cannot be divided further! Take air as an example. We can see in the sunlight that there are dust micro-particles in the air. In a garden, we can smell the fragrant micro-powders that come out of the flowers. All these indicate that there exist some indivisible things. Starting from these experiences, they drew the opposite conclusion;

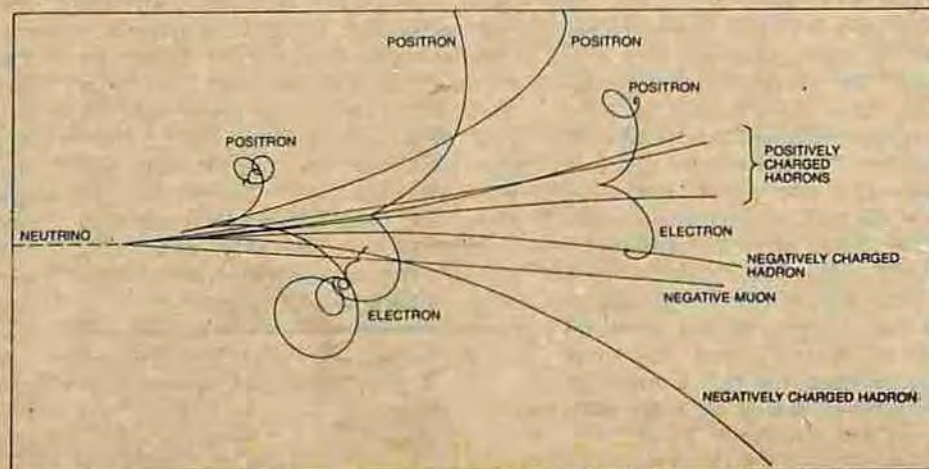
Everything in the world consists of micro-particles that cannot be further divided after being divided to some extent. These micro-particles were called "atoms" by Leucippus and Democritus of ancient Greece. The Mo School of our country in the later Spring and Autumn period called it "the end that cannot be chopped off." "The end of divisibility", meaning it has reached the bottom and cannot be divided any longer. They saw the aspect of relative indivisibility of matter. This viewpoint was, at that time, critical, aiming at the sophistry of abstract divisibility. There is an objective standard of the size of matter. There exist differences in quality; a needlepoint is different from the world. This reflects the indivisible aspect of matter. When we divide water down to water molecules, as far as water is concerned, it can no longer be divided. If we divide a water molecule further, it becomes two hydrogen atoms and one oxygen atom and is no longer water. Engels said, in physics we accept "certain...smallest particles"; "In chemistry there is a definite limit to divisibility". (*Dialectics of Nature*, p. 245). Because of this relative indivisibility, there can be molecules and

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2. (Translator's note)—475-221 BC when China was divided into different states at war with one another.  
 3. (Translator's note)—AD 220-265  
 4. (Translator's note)—770-476 BC. As a reference, Confucius was born in this period.  
 5. (Translator's note)—around the same time as Confucius. Han is a founder of the Legalist School.

6. (Translator's note)—ancient Chinese philosopher.

KEY TO PHOTO



# Matter

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atoms, a starting point of development for physics and chemistry.

But the indivisibility of atoms can also only be relative, not absolute. If one makes this indivisibility absolute, regards matter as absolutely discrete and denies the continuity of matter, then one will go into metaphysics and idealism. Newton was like this. He thought that the smaller matter becomes as it is divided, the firmer it gets. When its size is reduced to a certain micro-state, then it becomes so solidly firm that no force other than god's can divide it. This is the logic of objective idealism. Subjective idealism distorts indivisibility from another aspect. Berkeley and Hume both thought that since matter is no more than complexes of sensation, therefore, whatever is the smallest point that man can see, is indivisible. "A thing cannot exist apart from the mind that perceives it." (*New Essay on Vision*, Berkeley). Mach simply denied the existence of atoms. The reason being that he couldn't perceive atoms. These philosophers' outlook is: They can't see how matter is further divided, therefore matter is indivisible.

On the basis of the theory of atoms, Newton painted a "picture of the atomic world": All celestial bodies are constituted of discrete atoms, spottedly filling in the vacuum of the universe, moving incessantly in absolute space according to the laws of mechanical motion. All change and development of things in the world is no more than aggregation and dissociation of atoms. No matter how much things change, the origin of their change remains the same. Atoms themselves never change since they are created by god. Therefore, as long as man understands the motion of atoms, he can "know the past and future", know everything. In this way, Newtonian mechanics had become "final truth".

It thus seemed that absolute continuity is untenable, and absolute discreteness is also untenable. This is a contradiction. Kant perceived this contradiction in a deep way, and proposed an "antinomy": It is correct to say that everything in the world is composed of indivisible, absolutely simple things; because only an absolutely simple thing can be an elementary thing. Otherwise there could be no complex things composed of such elementary things, and there could be nothing in the world. By the same token, it is also correct to say that there exist no absolutely simple things; everything is some infinitely divisible complex thing, because no matter how simple a thing is, it must occupy some volume in space and thus can be continuously divided. Kant's "antinomy" exposed the contradiction and formulated this question. This was a necessary condition to advance to dialectics and push man's understanding forward. But Kant didn't solve the contradiction. Whether objective things are divisible or indivisible, continuous or discrete? His answer was: One doesn't know. He thought that objective things were unknowable anyway. If you insist on knowing, then the contradiction is produced. Therefore, this contradiction only comes from the "a priori illusion" of man's subjective cognitive ability. Thus Kant began by exposing the contradiction, but ended in covering up and reconciling the contradiction and fell into idealist apriorism.

On this question, still it was Hegel who said it right: Discontinuity and continuity "by themselves don't contain truth, only in their unity is there truth". Engels affirmed this viewpoint by saying that "matter is both divisible and continuous, and at the same time neither of the two, which is no answer, but is now almost proved". (*Dialectics of Nature*, p. 245). Subsequently, every step of development of natural science has continuously proven this scientific assertion of Engels', and has continuously revealed the rich content of various forms of matter as being both continuous and discrete.

## Object and Field

To understand the structure of matter, man initially classified matter into two opposing concrete forms.

In the beginning, man abstracted the concept of "object" [real thing] out of all the various forms of matter. The characteristic of objects is being "solid". Newton put forward that all objects are built up from atoms, the smallest object-particles. An atom is an absolutely discrete material point particle. It is "solid, block, hard, impenetrable". This is to say that the atom is an idealized solid thing, it is a highly concentrated object. Its fundamental characteristic is indivisibility; there is no "open space" inside. "Water can't be poured in, nor can a needle be inserted into" its inside. However, there can be no "solidness" without "void", no "what is" without "what is not". Objects are not hollow; all the emptiness has been pushed outside them. In ordinary life we see one thing after another, stars, mountains, houses, sand... all these are objects. But they can't fill up all space. What fills in between sparsely scattered stars is vacuum, between bushes there is vacant ground, even within a pile of sand there exist openings. If there are objects, there must also be the void. Therefore, in proposing the theory of atoms, Democritus said that in the world "only atoms and the void are real". The void is a necessary supplement to objects. This illustrates that the material world is always the unity of the discrete and the continuous. If matter is viewed as absolutely discrete objects, then it is necessary to realize the continuity of matter through the void in an upside-down way. The opposition of solidness and void is the opposition of the real and the empty, "what is" and "what is not". It is the initial "one divides into two" in the process of man's recognizing the material world.

But how do the solidness and the void, or "what is" and "what is not" unite together? Which one is fundamental? Lao Dan answered that "everything in the world is derived from 'what is,' and 'what is' is derived from 'what is not'". (*Laozi*, Chapter 40). That is, the void is fundamental, the object is derivative. This is idealist monism. Fei Wei of the Jin Dynasty [AD 265-420] wrote "On Promoting 'What Is'" to oppose him, saying that everything in the world must be derived from "what is", and cannot be derived from "what is not". This is materialist monism.

At bottom, Newton was a pro-"what is". He regarded the atom as the overall representative of objects and used it to paint an overall picture of nature, whereby matter is purely discrete and continuity is given over completely to the absolute void. The unity of discreteness and continuity in the internal structure of matter is described by him as the opposition of matter and nothingness. On the one hand, there is the absolutely dense object; on the other hand, the void of absolute nothing. The world is partitioned into two mutually exclusive unrelated halves. Newton couldn't unite these contradictory aspects. Finally he had to treat the void as higher than matter, and he slid from "advocating what is" down to "worshipping what is not".

Actually, how can Newton's absolute space be "absolute"? First of all, there is the mutual gravitational attraction among celestial bodies. Secondly, celestial bodies radiate light into the vast vacuum. These two phenomena must also manifest certain types of continuity of matter. Faced with this fact, Newton, in order to safeguard his absolute space, could only very artificially explain as follows: The attraction between celestial bodies is a kind of "action at a distance" exerting its force over space which is still empty; the ray of light is a kind of particle current ejected from celestial bodies and thrown into unbounded emptiness. The success of Newtonian mechanics in explaining mechanical motion did temporarily cover up the inconsistencies of his argument on these two questions.

7. (Translator's note)—This means "pair of opposites" but also connotes tension, opposition between them.

But where is this so-called absolute emptiness in the world? Doesn't air fill up all space near earth? Man therefore further imagined that in the vast space of the universe there probably existed some kind of continuous matter everywhere—ether or air.

The universe was said to be a continuous ocean of ether, a "Nature constituted by air". As Zhang Zai said: "The Empty Universe cannot be without air". Later Descartes of France and Huygens of the Netherlands proposed that all the space of the universe is filled with ether particles which join with each other and form a continuous medium; the particles squeeze one another, forming vortices. And these vortices sweep the moon to circle the earth and sweep the earth to circle the sun. As for light, it is waves of ether caused by the vibration of objects, just like a breeze of wind "blows waves in a pond of water". Up until the 19th century, more and more experimental facts demonstrated the wave-motion character of light; that light is just like a water wave and can go around obstacles. The theory of the wave motion of light achieved a decisive victory. The void was replaced by ether. The opposition between object and void gave way to the opposition between object and ether. Thus, the material world is divided, yet uninterrupted links are always there. The contradiction between discreteness and continuity in the structure of matter expressed itself as the opposition of two different kinds of material forms, and this, compared to the mysterious absolute emptiness, was of course a big advance.

In the 19th century, the research done on electromagnetic phenomena further advanced man's understanding of the continuous forms of matter. For example, when electrical current goes through a wire that surrounds a magnetic needle, the needle turns toward the direction perpendicular to the plane of the wire. What is this force that deflects the magnetic needle? Newtonian forces can only act along the direction of the straight line that connects the two objects. Obviously, *this* is another kind of "force" with completely different characteristics, i.e., the electromagnetic force which is completely different from the mechanical force. This is active in the vicinity of magnetic poles and electric charge. In order to describe the effect of the electromagnetic force, Faraday introduced many "magnetic lines of force" and "electric lines of force", imitating the method in fluid mechanics of using "stream lines" to describe fluid motion. Magnetic needles or electric charges are acted upon by a force along the direction of the magnetic lines of force and electric lines of force. The denser the "lines", the stronger the "force". Therefore, based on the configuration of magnetic and electric lines of force, the electromagnetic motion of objects can be graphically depicted. In this way, accumulating lines into planes and accumulating planes into volume, a "field" is constructed. Electric fields and magnetic fields mutually transform into one another, hence an electromagnetic field is formed. It was very artificial to use the vibration of ether to explain the motion of light waves in the past. Now it was much more straightforward to treat electromagnetic fields as a kind of medium that fills space in such a way as to transmit the electromagnetic effect. Thus, the field was developed from ether and replaced ether to become the overall representative of the continuous form of matter.

The discovery of the field as a form of matter was a very great achievement in science. It rejects mysterious emptiness, mysterious action at a distance, mysterious ether, and finds a practical, reasonable link between discrete objects, giving the continuity of material structure a material basis. One material world divides into two. It is no longer the opposition in appearance between matter and the void outside matter, but rather the opposition between two different kinds of material forms in the material world. It is the opposition between the discrete form and the continuous form of matter.

But then, that same old question comes back again: How do these two kinds of material forms unite? Some people imagined that object-particles

are like bricks and stones, and fields are like cement, and the universe has been built up by the gluing together of the two. In this way, discreteness is realized in objects, and continuity is realized in fields, but the two remain essentially absolutely separated and disjointed. The unity between discreteness and continuity of material structure remains as an external link of two completely different material forms. This is still a dualism on the question of material structure. Einstein felt unsatisfied with this. He tried to use the field, this kind of material form, to unify the world. He built up a "unified field" that embodies everything and paints a "world-picture of the field". Compared to Newton's world-picture of atoms, it reflects the continuity aspect of matter. But, the field cannot exhaust human understanding about material structure either. Einstein's "unified field" not only crudely wants to dissolve objects into the field, reduce object-particles to "condensations of field", but also crudely wants to "unify" everything. In this way, the field becomes like the ancient man's fire, water or air. It has again become the absolutely indivisible origin of everything. Once you recognize this unified field, then you can know everything from the universe down to particles, and exhaust final truth. As such, Einstein walked into a blind alley just like Newton did with his theory of the atom.

In the last several years of the 19th century, the gate of the atom was opened, man probed deeply into the secret of the atom. It turned out that the atom is not some absolute object; inside there are also particles and fields, another whole world. Electrons were the first to be found by man. This was the first resident of the atomic world which men recognized. Later it was discovered that in the center of the atom there is a hard core which contains over 99.95% of the mass of the atom, but occupies only several quadrillionths of the atomic volume. This is the atomic nucleus. The atomic nucleus carries positive charge and the electron carries negative charge; an electric field exists between them which links them together. From this, people proposed a planetary system model of the atom. The atomic nucleus is like the sun, and the electrons are like planets which circle the atomic nucleus along certain orbits through the action of the electromagnetic field, just like planets circle the sun through the action of the gravitational field. "A dust, a world", a tiny little atom is a small solar system! Later it was also discovered that the atomic nucleus is not something absolutely discrete and indivisible either. Within it there are neutrons and protons firmly bound together by the strong force—the mutual action of the meson field.

How can there be absolute [absolutely solid] objects? Within "solid" objects there are still more objects and fields. Within the material structure, these two are interconnected, interpenetrating, interpermeating, and interdependent. Take the hydrogen atom as an example. Its diameter is about  $10^{-8}$  cm, but its nuclear diameter is only  $10^{-13}$  cm, i.e., 100,000 times smaller. That is to say, adding the objects (the atomic nucleus and electron) of an atom together, they amount to only one thousand trillionth of the total volume. The rest of that vast volume is all electromagnetic field and gravitational field. By analogy, if we magnify a hydrogen atom to the size of a big theatre, the atomic nucleus would be like a sesame seed in the middle of the theatre, and the electron would be like a piece of dust flying along the wall. How could such an atom be "solid"? The proton and neutron inside the nucleus also amount to only several tenths of the total nuclear volume, the rest being filled up by electromagnetic field, gravitational field and meson field. How can it be counted as a [solid] object? And these many wavelike inside the atom also themselves divide into two

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8. (Translator's note)—A quadrillion is a thousand trillion or a million billion, i.e., 1,000,000,000,000,000. Text says "several trillionths". This is a typographical error. A "quadrillionth" is one out of a quadrillion.

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families. There are the hadrons [heavy] and the leptons [light ones], which are the bricks and stones; there are also meson fields and photon fields, which are the cement." The opposition of discreteness and continuity penetrates deep into the interior of the atom.

Engels says that: "Dialectics knows no hard and fast lines, no unconditional, universally valid 'either-or'." (*Dialectics of Nature*, p. 212). Particles and fields are both different and connected. There exists continuity within the discreteness—a [solid] object is not "solid". No matter how hard bricks are—even a block of iron, there still exists empty space inside. There is also discreteness within continuity; inside cement there are particles. [The concepts of] particle and field are only generalizations reached on a certain level of the development of science, the products of a certain stage of man's understanding of material structure. The development of science is penetrating into deeper levels of material forms. It more and more illustrates that they are [not "either-or" but] "both-and", no hard and fast lines!

## Particles and Waves

The further development of science demonstrates that the residents of the atomic world—wavicles—themselves are both discrete and continuous. "Only in motion would objects reveal what they are" ("Engels to Marx" 5-30-1873—[translated from Chinese]). Precisely in motion, wavicles manifest themselves both as particles and as waves.

What is light? In the 19th century man thought that light was just an electromagnetic wave. But some experiments conducted at the end of the 19th century indicated that the energy of electromagnetic waves was not being radiated continuously, but rather jumping—one by one. Just like when one buys things and pays money for them, the smallest unit of money is one cent which can't be partitioned any further, when things radiate energy or absorb energy there is also a smallest unit which can't be divided anymore. This unit is called a "quantum of energy" or simply "quantum". The energy quantity is discrete, this means the subject in motion [embodiment of energy] is also a discrete particle, which is called a photon. Light exists not only as wave, but also as particle. On the other hand, it was later discovered that particles also have wave [characteristics]; there are electron waves, neutron waves, proton waves. Particles are not only like "ice hail, rain drops", but also like "flying cloud, flowing water". An electron beam, like a light beam, when it passes through a tiny hole, also produces a wave-type diffraction pattern. This also demonstrates that the electron not only is a particle, but also a wave. In sum, all wavicles, whether electrons or photons, or say bricks or cement, all are like "one actor playing two roles". They are all both discrete and continuous, exist as both particle and wave. This is really like: [Within particle there is wave and within wave there is particle!]

It won't do for science to simply recognize that micro-objects possess the duality of being wave and particle. Science must "study how opposites can be and how they happen to be (how they become) identical" (Lenin, *Philosophical Notebooks*, Collected Works, Vol. 38, p. 109), and study how this duality "resides" in the concrete structure of micro-objects.

This is difficult. If waves are the vibrations of fields and particles are the barrage of "bullets" fired directly out from a thing, then how could these be united? Someone said that in the final analysis, it is a wave. Several different waves overlap one another, wave peak meets wave peak and reinforce one another. If many wave peaks concentrate at one place, forming a "wave packet" they become a particle. But this wave packet is very unstable, quite easily dissipated and cannot maintain its particle character. There are also some people who say that in the final analysis it is a particle. In the process of motion, particles go up and down, one pulls another, forming vibrations, and the vibrations are transmitted in wave form. This is just like travelling in a hilly area; a car takes a wave-like route. This is actually still the old viewpoint of the classical school of particles. It can't solve the old question of the diffraction and interference of light.

The Copenhagen School headed by Bohr proposed a new explanation for micro-objects' duality as both particle and wave. They thought that a micro-object acting as an individual is a particle. But when it repeatedly appears under the same conditions, it appears more frequently in some places and less in others. The distribution density of various places varies, forms peaks and valleys at different places, and is just like a wave. This is called a "probability wave". "If we let the electrons go through a tiny hole and project them onto a screen, one at a time, in the beginning we can only see one after another irregularly distributed spots. The electrons have hit here and there, making them seem very 'free'. But when the total number of electrons going through a tiny hole has increased to a very large number, concentric rings appear with alternating bright and dark shades. The dark areas indicate where fewer electrons have hit, and the bright areas where more electrons have hit. As far as an individual electron is concerned, it is not certain what path it would take and where it would hit. We can only say what would be the probability of it hitting a given point. In the whole area that the electron could have hit, a regular continuous probability distribution has shaped up—a "probability field". Therefore, the unity between the particle and wave character of an electron in fact lies in the unity between its particle character and the probability distribution that it expresses in motion. The electron wave is different from the light (photon) wave. It is another special type of wave, i.e., the "wave" formed by the probability of a particle occurring at different places.

According to this explanation: Within an atom, as an electron circles around the atomic nucleus, it cannot have an exact orbit and location. It can only have a probability distribution, and forms a "probability field". The electron can be here, and can be not here. It is only, in the main, located inside an "electron cloud" and there is no way to pinpoint the exact location of an electron.

Probability waves demonstrate that between discrete particles there are still connections; they express the continuity between particles through probability waves. This reflects the contradiction of wavicles being both discrete and continuous. It is seemingly discrete and continuous, not discrete and not continuous. It contains discreteness within continuity and continuity within discreteness. Why is there such a contradiction? It can only be explained through the internal structure of wavicles—because there are still deeper structural levels below wavicles, which themselves can be further divided.

11. Probability is the measure of possibility. It deals with the laws governing events which repeatedly occur under the same conditions. For example, flip a coin. For an individual coin, it is completely uncertain whether the face would be heads or tails, it can be heads and it can also be tails. But if one flips a coin many times, or flips many coins at the same time, the results approach a probability distribution of 1/2 for heads and tails respectively. This law is called a statistical law.

However, the Copenhagen School thought that this type of connection is "freely chosen" by its own free will, no causality involved here at all. Electrons show no trace of coming and going, but only meet at the "scintillation screen". And as to why it hits at this particular point on the scintillation screen, there are no trails for us to trace, no indications which would allow us to predict, no before and after phenomena for thinking over. Man can only use different types of "instruments" to make wavicles express themselves in some experiments as particles and in other experiments as waves; and these two aspects are mutually exclusive and complementary, forming a "complementary world-picture". This is to say, matter expresses itself here as particle, there as wave; today it is particle, tomorrow field. Two things alternately stand out in prominence, one can't do without the other; Newton said there are only particles in the world; Einstein said there are only fields; the Copenhagen School said the world is constituted half as particle, half as field, half discrete and half continuous. And these two halves are simply put together "combining two into one", that is it, no more and no less.

Why is there such a result? Heisenberg said, "Just as the Greeks had hoped, we have by now found the only elementary object which is actually in existence". This is the quantum of energy, i.e., the "elementary particle", which is "the smallest indivisible unit of all matter". (*Philosophical Questions of Nuclear Physics*, 1948, British edition, p. 103, [translated from the Chinese]). This quantum sets the final limit of analysis. Within this limit, man can accurately measure a certain quantity, can investigate in a thousand and one ways the various relations outside of the "quantum"; but once having gone beyond this limit and getting within the quantum, everything becomes blurry. If you want to pinpoint the exact position of a particle, then speed won't be certain. If you want to make certain of its speed, then location becomes blurry. In sum, precisely because the quantum is indivisible, the micro-object is either shown as particle or as wave. And we can only describe them as particle or describe them as wave. This is our final description of micro-objects. Our understanding of the material world can only go this far and must stop here. Deny the absolute divisibility of matter and you inevitably get into this blind alley of "final truth".

How can there be some so-called absolutely indivisible thing? The atomic world is complex, inexhaustible, and with the development of science, man will for sure penetrate to ever more aspects of this world, understand ever more manifestations of micro-objects. Whether "quantum", electron, or photon, it is all "a 'nodal point' in a partitioned infinite series; it does not conclude this series, but rather characterizes the differences of quality" ("Engels to Marx" June 16, 1867 [translated from the Chinese]). These nodal points are the unity of absolute divisibility and relative indivisibility. If electrons and photons cannot be further divided, our understanding has reached the ultimate. Then what have scientists left to do?

## No "Elementary Matter"

A wavicle is not some "elementary particle", it can still be divided. A wavicle has a very prominent characteristic, i.e., under certain conditions, it changes instantly, transforms ceaselessly. "In given conditions each of the contradictory aspects within a thing transforms itself into its opposite." (Mao Tsetung, *On Contradiction*) Transformations are always due to internal contradictions; one divides into two internally. Without the internal contradiction between protons and neutrons within the radium nucleus, it wouldn't radiate an alpha-particle and transform itself into radon. Without the internal contradictions between sperm and ovum within a chicken egg, it couldn't transform itself into a chick. If capitalist society was like a block of iron, and there was no contradiction between capitalist production relations and social productive forces, no contradiction between the bourgeoisie and the proletariat, how could it transform

itself without cause or reason into socialist society? Things won't occur without a cause; no wave without wind blowing. Without contradiction there can be no transformation. This is a universal law. The reciprocal transformations of wavicles similarly indicates that wavicles are divisible. They contain internal contradictions.

In the West there is a theory that wavicles are all "equal". Between them there is only the mutual relationship of I link up with you and you link up with me. Thus, the relationship buries the real object. Finally, in this view, not only is there no "level structure", but no "particles"; there is no such thing as "field"; and therefore, of course, no so-called "internal contradictions" of wavicles. This theory uses solely the external links of things to abolish the internal contradictions in things. The 3-D picture interwoven of vertical (series of different levels of material structure) and horizontal (cross section of the same level) fabric of the material world, once being put into the "funny mirror" of this theory, is twisted into a flat picture of only a horizontal cross-section, but no vertical depth. There is another theory which argues that wavicles are only "geometrical points" without internal structure. Then how could they transform? In order to realize this transformation, this theory has to resort to particles emerging out of the void, and disappearing without cause. But the smaller the radius of a particle, the larger the energy. Infinitesimal "geometrical points" must carry an infinitely big energy. This theory thus lands in an inescapable quicksand.

The development of natural science itself continuously confirms the divisibility of wavicles. In the 1950s, S. Sakata of Japan put forward a theory that in the hadron-meson family of wavicles, there are 3 even more basic "fundamental particles" whose unity of contradiction forms all the rest of the hadrons and mesons. Subsequently, some people put forward on the basis of Sakata's model, that all the particles in the hadron-meson family are composed of 3 "fundamental hadrons" called "quarks". In recent years, still other people put forward that even a single type of quark can still have different "colors" or other different characteristics, demonstrating that quarks actually are not "fundamental", but possess differences. Recently, a "partial-particle" model was also presented. Based on the results of experiments which showed that when high-energy electrons hit a proton, the electrons are not hitting a solid ball, but rather some discrete points, some people conjectured that the proton probably is composed of "partial-particles" which are even smaller than the proton. Currently, science is charging from various angles into the internal world of wavicles.

Faced with the facts of scientific development, Heisenberg searched for the "fundamental particle" more basic than the wavicle. This was an advance. But he still thought that all the "fundamental particles" are identically the same, no contradiction; and he thought they form an "elementary field" which includes all the wavicle fields and contains no contradictions at all. This is his so-called "unified field theory", and it is the "final theory" which can exhaust all human understanding of material structures in one stroke. He tried in the small world to set a lower limit for the universe, just like Einstein tried in the big world to set the "unified field" as an upper limit for the universe. Both are in vain. Heisenberg just advanced one step, then fell back again into the swamp of metaphysics. You see how stubborn this metaphysical world outlook is!

What is strange is that some Soviet revisionist scholars who say they are using Marxism as a guide, have also joined the big chorus against the divisibility of wavicles. They cried that: "Wavicles are 'non-composite', no longer 'composed of other even simpler material particles.'" The "non-composite" means no internal contradictions. But they also boast that the reciprocal transformations of wavicles have demonstrated their complexity and inexhaustibility, and they seem not to oppose Lenin on the principle that the

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9. The known wavicles are classified into 4 "families" generally according to their mass: (1) Hadron [heavy particle] family, including protons, neutrons, and hyperons; (2) Meson family including  $\pi$  mesons, K-mesons; (3) Lepton [light particle] family, including electrons, neutrinos, and muons; (4) photons.

10. (Translator's note)—here the text makes reference to a popular Chinese love poem which expresses the unity of two lovers.

# Pesticide

Continued from page 9

ular spraying, whether or not there are dangerous numbers of pests in the field. The farmer was also caught when trying to market produce. Many canneries, for example, will not even accept fruit for canning unless it has come from fields that are regularly sprayed, whether there are pest infestations or not. The highly monopolized distribution and sales of fruit and vegetables, under imperialism, demands visually perfect fruits and vegetables, even though they are laced with pesticides. In addition, it means that the produce have a homogenized, average taste, and have a lower nutritional content, because they are not tree-ripened, for example. This is typical of highly developed capitalist commodity production—the use-value of the product is of no concern to the producer; it just has to look good in the market, so it will sell. (Quite like American cars, for example.) Millions of dollars of poison each year are dumped on the citrus crop in California to kill the citrus thrip, a small insect that does nothing except make lines on the skin of oranges and lemons.

## Battle in Scientific Sphere

This whole system of pesticide madness, even though it is poisoning the earth, poisoning farmworkers, poisoning the whole population, costing billions of dollars a year, and has created much worse pests than existed in the first place, is indeed a cobra that the imperialists cannot release. More than that, it is one that they ruthlessly fight to maintain, strengthen and defend.

Robert van den Bosch, the author of the book *The Pesticide Conspiracy*, describes a number of cases where scientists who have dared to write studies critical of current agricultural practices have been fired from university posts. He describes the function of the Entomological Society of America

as a bludgeon for pesticide use, and shows how its leaders turn like jackals on any expert who opposes pesticide madness on scientific grounds. The effect of all this has been that the U.S., which likes to parade around the world as the model of advanced, scientific agriculture, has tremendously held back the development of real understanding of pest control problems. In what could equally be a description of the entire superstructure of imperialism, van den Bosch writes:

"There is, then, a pro-pesticide 'mafia', whose members operate much in the manner of those in its Italian namesake. It has its *famiglie*, its *capi*, its *consiglieri*, its *soldati*, its *avvocati*, its lobbyists, its PR apparatus, and its 'hit men'. It owns politicians, bureaucrats, researchers, county agents, administrators, and elements of the media, and it can break those who don't conform. In other words, it is a virtual duplicate of the other 'mafie' that pervade and dominate so much of contemporary American society."

Many of the rebels among the agricultural experts, who go up against the "mafia," point to and uphold the tremendous accomplishments of revolutionary China in developing really scientific methods of pest control when it was a socialist country. China was able to solve many pest control problems much more difficult than the Medfly by unleashing the conscious initiative of the masses of people in every sphere, including scientific experiment. This, of course, was possible because Mao's political and ideological line was leading the working class and the oppressed in class struggle against the bourgeoisie in every sphere of society and on that basis toward the conscious mastery of society and nature.

Capitalist domination—in society as a whole, including scientific circles—has determined much of the abysmal ignorance and anarchic fumbling that has run through the battle from beginning to end. Another particularly sharp way that this has come out is around the

question of whether or not malathion is safe to spray on millions of people. In the middle of July, when the battle was very sharp over whether or not aerial spraying would start at all, there was a lot of play in the bourgeois press given to the few scientists who had the nerve to come out publicly and say that they felt that malathion was indeed potentially dangerous, especially in its long-term effects. Since that time, the question has been largely ignored by the press, and the view that malathion may well cause damage to genes, cause birth defects, and cause cancer has mainly been suppressed.

There are several reasons for this. One is that at the start, during the sharpest period of mass struggle, the press was not able to totally ignore the danger that malathion posed. More important than that, they allowed some public airing of the view that malathion was dangerous, in order to attempt to smash this view even more completely. The bourgeoisie is relying on people to think that because the furor has died down, and no one is keeling over and dying (although some large dogs have), malathion is safe. On the other side of the coin, some of the scientists who originally made the statements have been effectively silenced.

A professor of pharmacology at Stanford, Dr. Sumner Kalman, who filed in the continued huge trade imbalance spraying was dangerous, has been vilified by some other so-called experts, and now refuses to talk to the press. Another man, Marc Lappé, was fired from his job as Chief of Hazard Evaluation in the Dept. of Health for writing a report that said that there was a possibility that malathion might be dangerous, and more research needed to be done. Lappé told the *RW*, "There is a strange and merciless amount of vendetta going on for people who have taken this position." He also said, "And the irony is that the unit that I directed, because we anticipated that there would be a requirement for a risk assessment, we were the only unit in the state that was prepared to do it even though it was outside our domain, that is, we had sent for the initial literature search as soon as we heard that malathion might be sprayed. And it adds a little bit of irony to it that because we took that initiative and were asked as a favor to the Department to do the analysis, then we're iced out of the final policy decision. That we then get penalized for it."

The underlying truth to all this is that no matter how much imperialism tries to suppress, distort, and hide all this, it still exists, the insect pests still grow stronger in the fields under pesticide showers, and the long-term effects of malathion will manifest themselves, and people—some now, some later—will recognize that, and put the blame where it belongs. There has been some talk among the Medfly chieftains of the possibility of using even stronger pesticides than malathion. Should they dare, there is no doubt that the effect will be exactly the same as in the fields—stronger, fiercer, quicker resistance by the pests. Already what has been done with the aerial spraying has pushed even further the already frayed allegiance of some of the more privileged sections of the people.

## Conflict with Japan

Another significant aspect of the Medfly wars which shows the straining limits of U.S. imperialism is the effect this has had on U.S. relations with Japan. This is one of the most important relations within the whole U.S. war bloc, and a highly strained one at that. A whole series of U.S.-Japan "crises" have marked the past year, including that over auto import quotas, the Medfly-fruit fumigation question, and most central to it all, the deliberate flaunting by the U.S. of news that it has long harbored nuclear weapons on Japanese soil.

The foundation of all of this, as both U.S. and Japanese imperialist spokesmen like to call it, is "our need for each other": that is, the U.S. need for Japan as the anchor of its war strategy in Asia, and the need of the Japanese imperialists for shelter—and expansion—under the U.S. military umbrella.

Yet, these countries are still imperialist, and as such inevitably come into collision over various issues, most openly over economic ones like trade. A substantial part of the U.S. balance of trade deficit is with Japan. While the U.S. imperialists must maneuver to reduce this, the pressure they can apply is limited by their overriding need to hold Japan and strengthen her role in the war bloc—a complex tug-of-war has ensued, of which the Medfly issue is a good (if not the biggest) example.

In late August, Japan moved to bar all shipments of produce from California ports regardless of whether their origins were in Medfly-infested areas, insisting that all fruit to Japan be fumigated. Two weeks of intense maneuvering and veiled threats ensued. Reagan sent a special trade envoy to Tokyo who warned of "intense political response" if "problems" like the fruit ban resulted in the continued huge trade imbalance.

The Japanese imperialists followed with their own threats. Tsuo Yamashita, a Japanese diplomat in Washington, compared the crisis to the auto import situation. Yamashita noted that Japan had produced a voluntary restriction on its outgoing autos only after the U.S. had hinted of an immediate import quota of its own. But since the U.S. quota had been "just speculation" (i.e., a threat), deadpanned the diplomat, so, too, Japan's hints that it might soon impose a permanent fruit quarantine "were also just speculation."

The final agreement, reached on September 8, was that Japan would accept fruit from California from areas where there were no Medfly infestations, if it was fumigated with ethylene dibromide, an extremely poisonous chemical, known to cause cancer, sterility, and liver damage in rats. In fact it is one of the most carcinogenic chemicals. Its effects on humans have not been studied. As soon as this decision was reached, and both Japan and the U.S. were satisfied that the interests of each set of imperialists were satisfied, the Longshoreman's union announced that its members would refuse to even touch crates of fumigated fruit—fruit that Japan's rulers, after weeks of delicate negotiations, had decided was fine for the masses to eat.

We can only await the next brilliant move by U.S. imperialism in this, its latest glorious battle. □

# Matter

Continued from page 22

electron is inexhaustible. Without contradiction, how can it still be "inexhaustible"? What is the source of reciprocal transformation? Lenin says that contradiction "alone furnishes the key to the 'leaps', to the 'break in continuity', to the 'transformation into the opposite', to the destruction of the old and the emergence of the new" (Lenin, *Philosophical Notebooks*, Collected Works, Vol. 38, p. 360). May we ask, how can your high-sounding thesis about transformation without contradiction be reconciled with Lenin's teachings?

In what way will wavicles be divided? It can't be a routine way, and blindly applying the old experience. The molecule is divided into atoms, gravitational field and electromagnetic field; the atom is divided into atomic nucleus, electromagnetic field, and electron; the atomic nucleus is divided into proton, neutron and nuclear field. On every level they all are the new form of unity between particle and field; they all are new nodal points, and they are all qualitatively different. Into what forms will wavicles be divided? It is possible it will be the current form of unity between particles and fields. It is also possible a big qualitative change will take place, giving rise to a new discrete material form and a new continuous material form; they would be new things different from both the particles we know by now and the fields we know by now. It is possible that they will be divided smaller and smaller, but it is also possible that they will be divided bigger and bigger. What will be pulled out of wavicles may possibly "grow fatter", become bigger than when it was inside. This might lead to a new development of the relationship between the part and the whole. What would it turn out to be? This is a concrete scientific question. Matter has infinite diversity, the concrete division of matter also has in-

finite diversity. "Marxism-Leninism has in no way exhausted truth but ceaselessly opens up roads to the knowledge of truth in the course of practice" (Mao Tsetung, *On Practice*). Dialectical materialism never issues forth into other spheres to give orders; it doesn't draw conclusions on this question, substituting itself for natural science.

We talk about division, one divides into two, that is "the division of a unity into mutually exclusive opposites" (Lenin, *Philosophical Notebooks*, Collected Works, Vol. 38, p. 360) This is to say that there are contradictions within any material form. The whole history of the development of natural science has shown: In the world there is simply no such thing as "elementary matter" that doesn't contain contradictions. Every new thing, when it first emerged, was portrayed as being "elementary matter". The element was like this; the atom was like this; the gravitational field and the electromagnetic field were like this; the wavicle is also like this. But not for long. "Up till now we thought we had ascended to such a position as having a view of a thousand miles, but it turned out that we had only ascended one floor." Things more elementary than "elementary" have repeatedly emerged. If the wavicle is the "elementary particle", if it's as small as can possibly be, then what would scientists have left to do?

Lenin said: "the electron is as *inexhaustible* as the atom" (*Materialism And Empirio-Criticism*, p. 314, FLP). This is a very profound truth. Natural science is always proceeding to deeper levels. New things have always emerged without end. The development of science has ceaselessly negated the existence of "elementary matter." The "Big World" has no boundary. The "Small World" also has no end, truly a "bottomless hole". This is an historical fact of several thousand years of development of natural science. This historical fact is worthy of attention. These two opposing views on material structure, that is the struggle of the two world outlooks over this question of material structure, needs our study. □



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