

EIR Science & Technology

CFCs are not depleting the ozone layer

Rogelio Maduro reports some startling statistics: One active volcano, can emit more allegedly ozone-depleting gases than all man-made sources combined—there's still enough ozone.

Amid predictions that a cataclysmic depletion of the ozone layer would occur if production of chlorofluorocarbons (CFCs) is continued, representatives from 80 nations have agreed to a total ban on these highly useful chemicals by the year 2000. The stampede occurred at the end of a United Nations Environment Program conference on protecting the ozone layer in Helsinki, Finland, May 1.

The insane decision goes much beyond the Montreal Protocol, signed in 1987 by 17 nations, which calls for the production of CFCs to be cut in half by 1998. The resolution also agrees to phase out "as soon as feasible" other "ozone-damaging" substances such as halon gas, which is used in fire extinguishers. The resolution is a "declaration of intent" which is to become an enforceable international law during another climate conference in 1990.

The problem is, the "ozone depletion" scare is a hoax, and this well-orchestrated and -financed campaign to phase out and ban the production of CFCs, some of the most useful chemicals ever known to man, is taking place despite the fact that there is no scientific evidence whatsoever to prove that CFCs are depleting the ozone layer. This author has previously reviewed evidence of the discovery of the "ozone hole" in Antarctica by the foremost researcher of the ozone layer, Gordon Dobson, in 1956, years before man-made CFCs were in widespread use. Here, we will disprove the claims that CFCs are adding to the destruction of the ozone layer.

Atmospheric chlorine and volcanism

For example, volcanoes contribute vastly greater amounts of chlorine and other "damaging" chemicals to the atmosphere

than any man-made sources.

CFCs are some of the most useful and non-toxic chemicals ever invented. They are critical for sterilizing medical equipment, as refrigerants, as solvents in the electronics industry, and as foaming agents to create insulation.

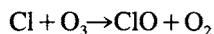
The hoax that CFCs are destroying the ozone layer is based on a technical scare paper written by F. Sherwood Rowland and Mario Molina in 1974. A good illustration of how the fraud is pushed on the public is a description of Rowland's claim in the July 1988 issue of *Physics Today* magazine, which states, "While the inert nature of CFCs makes them attractive for many applications, it makes them troublesome as well. The two most common species, CFC-11 and CFC-12, remain in the atmosphere about 75 and 120 years, respectively. After about five years in the troposphere, they are transported into the stratosphere."

Physics Today continues, "Ultraviolet rays [in the stratosphere] ultimately dissociate [CFCs] into free chlorine atoms and other molecular fragments."

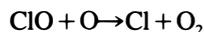
According to the claims of Rowland, the following chemical reaction for CFC-12 (Freon, the refrigerant which keeps your food from spoiling and your car from becoming an oven in the summer) takes place in the stratosphere. The chemical formula for CFC-12 is CCl_2F_2 , and, supposedly, it undergoes the following reaction in the stratosphere:



The single chlorine atom then combines with an ozone molecule to form a chlorine monoxide molecule (ClO) and molecular oxygen:



The chlorine monoxide molecule left by this step is also quite reactive, and according to Rowland's claims, it quickly combines with atomic oxygen in the stratosphere to release another oxygen molecule and more atomic chlorine:



According to *Physics Today*, "The net result is that ozone molecules are removed from the stratosphere and chlorine atoms are free to begin the process over again. A single chlorine atom may destroy hundreds of thousands of ozone molecules during its residence in the stratosphere. This reaction cycle is interrupted when the free chlorine atoms become sequestered in so-called reservoir compounds."

It is all so simple: a doomsday machine. Actually, it is a Pac-Man version of atmospheric chemistry—an ozone-gobbling chlorine monster has been unleashed by mankind's pursuit of economic development and desire to feed his hungry population.

Fortunately for mankind, Rowland's theory has more holes than the ozone layer.

Big Lie #1: CFCs are heavy, complex molecules. It is a mystery how vast amounts of these molecules could (supposedly) rise to the stratosphere. There has yet to be published a single scientific paper which presents any documented *observations* of large numbers of these molecules rising to the stratosphere. It is especially difficult to see how they can rise as high as 30 km, where the greatest concentration of ozone is located. Present claims are based solely on the supposition that CFCs *will* rise to the stratosphere *because* they are not water soluble molecules.

Big Lie #2: Do these chemical reactions occur at all? As pointed out in the April 28 issue of *EIR*, Sherwood and Molina carefully prefaced their 1974 technical scare paper with the following: "We have *attempted* to calculate the *probable* sinks and lifetimes of these molecules [emphasis added]." In short, although the chemical reactions described have been carried out in laboratory experiments, the reactions of CFCs in the stratosphere have never been either observed or measured. Sherwood and Molina have based their *theoretical model* on just a few chemical reactions in a laboratory setting, when at least 192 chemical reactions and 48 photochemical processes have been observed to occur in the stratosphere.

Big Lie #3: As *Physics Today* stated it, "A single chlorine atom may destroy hundreds of thousands of ozone molecules during its residence in the stratosphere." To restate the point, CFCs do not destroy ozone: They are inert, non-reactive, non-toxic, non-flammable chemical compounds. But the claim is that, high in the stratosphere, ultraviolet radiation breaks up the CFC molecules, a molecule of chlorine is released, and it is this molecule that allegedly destroys the ozone layer.

If this claim were true, then the ozone layer should have

ceased to exist millions of years before man ever emerged from the caves to burn his first biomass. Chlorine happens to be one of the most naturally abundant trace chemicals in the atmosphere. The natural sources of chlorine in the atmosphere so dwarf the puny amounts of chlorine that could possibly be released by CFCs, that it would be truly embarrassing to the scientists implicated in this hoax if the existence of these natural sources were reported by the news media. Therefore, they have not been reported.

The yearly production of CFCs is presently estimated at approximately 1.1 million tons a year, which includes approximately 750,000 tons of chlorine. Compare this to the natural sources of chlorine gases.

- Some 300 million tons of chlorine are released into the atmosphere every year by the evaporation of sea water, which contains salt (sodium chloride, NaCl). Large amounts of this chlorine reach the stratosphere through the pumping action of thunderstorms, hurricanes, typhoons, and other cyclonic activity, which also break up the sodium chloride molecules.

- Between 11 and 36 million tons of chlorine gases are released by passively degassing volcanoes in years with no great volcanic eruptions.

- There are 4.2 million tons of chlorine gases produced by the burning of biomass, largely as a result of Stone Age slash-and-burn agriculture methods.

Figure 1 is a comparison between the natural sources of chlorine and chlorine in CFCs.

One of the scare stories being spread is that there is 50 to 60 times more chlorine in the atmosphere in Antarctica than scientists had expected, and therefore, CFCs must be arriving at the South Pole in dangerous concentrations. What is carefully covered up, is that less than 15 kilometers upwind from the observation station at McMurdo Sound, is Mt. Erebus, an active volcano that has been constantly erupting for the past 100 years. From observations made in 1983 by William Rose of Michigan Technological University, it has been estimated that Mt. Erebus was ejecting more than 1,000 tons of chlorine a day into the atmosphere. This comes to about 370,000 tons of chlorine a year, which in 1983 was almost as much as the entire world's *production* of chlorine for CFCs, about 580,000 tons (**Figure 2**).

In short, the chlorine that the scientists are reading in Antarctica may include a couple of molecules of chlorine from CFCs, but most of it is clearly chlorine from Mt. Erebus. This leaves a big gaping hole in the ozone hole theory.

It should be pointed out that, according to calculations of different volcanologists, the amount of chlorine yield of Mt. Erebus between 1972, when observations started, and 1983, when direct measurements of the volcano plume took place, was approximately 1-2% of the estimated global volcanic flux. The range of calculated worldwide chlorine flux from volcanoes is between 11 million and 40 million tons, with 36 million tons being a reasonable estimated average, according to several volcanologists interviewed by *EIR*. This means

that in a year with no great volcanic eruptions, passively degassing volcanoes eject more than 48 times more chlorine into the atmosphere than all the chlorine contained in man-made CFCs (Figure 3).

The eruption of one volcano, Tambora, in 1815 released a *minimum* amount of 211 million tons of chlorine gases into the atmosphere. At present production rates of CFCs, it would take mankind more than 285 years to put as much chlorine into the atmosphere as Tambora did in a few weeks.

According to the Rowland ozone depletion theory, such a catastrophic release of chlorine should have wiped out the ozone layer completely, flooding the Earth with cancer causing ultraviolet rays. Well, mankind still walks the surface of the Earth, and there is no record in the early 19th-century of mass extinctions of human, animal, or vegetable life due to skin cancer or other effects of increased ultraviolet radiation (Figure 4).

A more recent eruption, that of El Chichón volcano on the Yucatan Peninsula of Mexico, is an even better indication that large increases in stratospheric chlorine gases do not have a significant effect on the ozone layer. In March and April 1982, there were major eruptions of El Chichón, which injected large amounts of gas and particles into the lower stratosphere. A coherent volcanic cloud was soon established in a zonal band circling the Earth. Several months after the eruption, several aircraft flew through the volcanic cloud

measuring the concentration of gases in the stratosphere. William G. Mankin and M. T. Coffin from the National Center for Atmospheric Research, published the results of some of the flights in the Oct. 12, 1984 issue of *Science*. He reported that El Chichón injected more than 40,000 tons of hydrogen chloride (HCl) directly into the stratosphere, "about 9% of the global stratospheric HCl burden." In the wide band where the volcanic cloud stretched, the amount of stratospheric HCl increased by 40% over previous values. Mankin and Coffin end their article by stating that Stolarski and Ciccone, two of the scaremongers warning about ozone depletion, "originally suggested that the direct injection of chlorine into the stratosphere by volcanoes could result in substantial O₃ destruction, but this source of stratospheric chlorine has largely been dismissed in comparison with other sources. The observation that a single, large volcanic event can increase the stratospheric HCl burden by 40% over a large part the globe should lead to a reassessment of the role of volcanoes in stratospheric chlorine chemistry."

In fact, the predicted "substantial" destruction of the ozone layer by the stratospheric chlorine did not occur.

Two years before the El Chichón eruption, a leading volcanologist, David Johnston, had raised the issue of the large amounts of chlorine released by volcanic eruptions, compared to man-made sources. In a scientific paper published in the July 25, 1980 issue of *Science*, Johnston states

FIGURE 1
Natural sources of chlorine gas emissions vs. chlorine in CFCs

(Millions of tons)

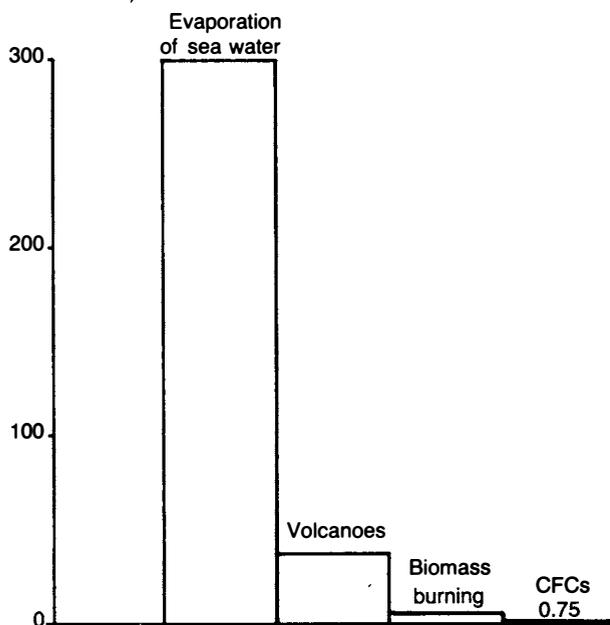
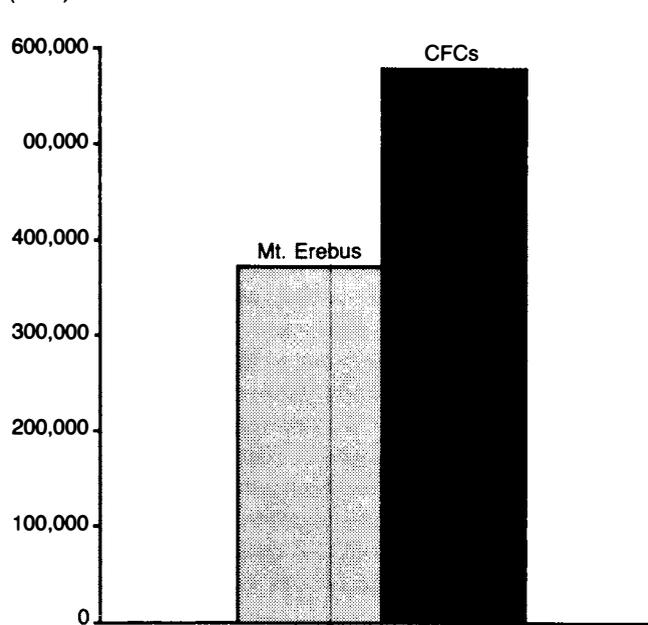


FIGURE 2
Mt. Erebus, Antarctica chlorine emissions vs. CFCs (1983)

(Tons)



“Earlier estimates of the chlorine emission from volcanoes, based upon evaluations of the pre-eruption magmatic chlorine content, are too low for some explosive volcanoes by a factor of 20 to 40 or more. Degassing of ash erupted during 1976 by Augustine Volcano in Alaska released 525,000 [metric tons] of chlorine, of which 82,000 to 175,000 [metric tons] may have been ejected into the stratosphere as hydrogen chloride. . . . The amount of chlorine in the estimated total atmospheric and stratospheric injections corresponds to 107 and 17 to 36%, respectively, of the 1975 world production of chlorine in fluorocarbons.”

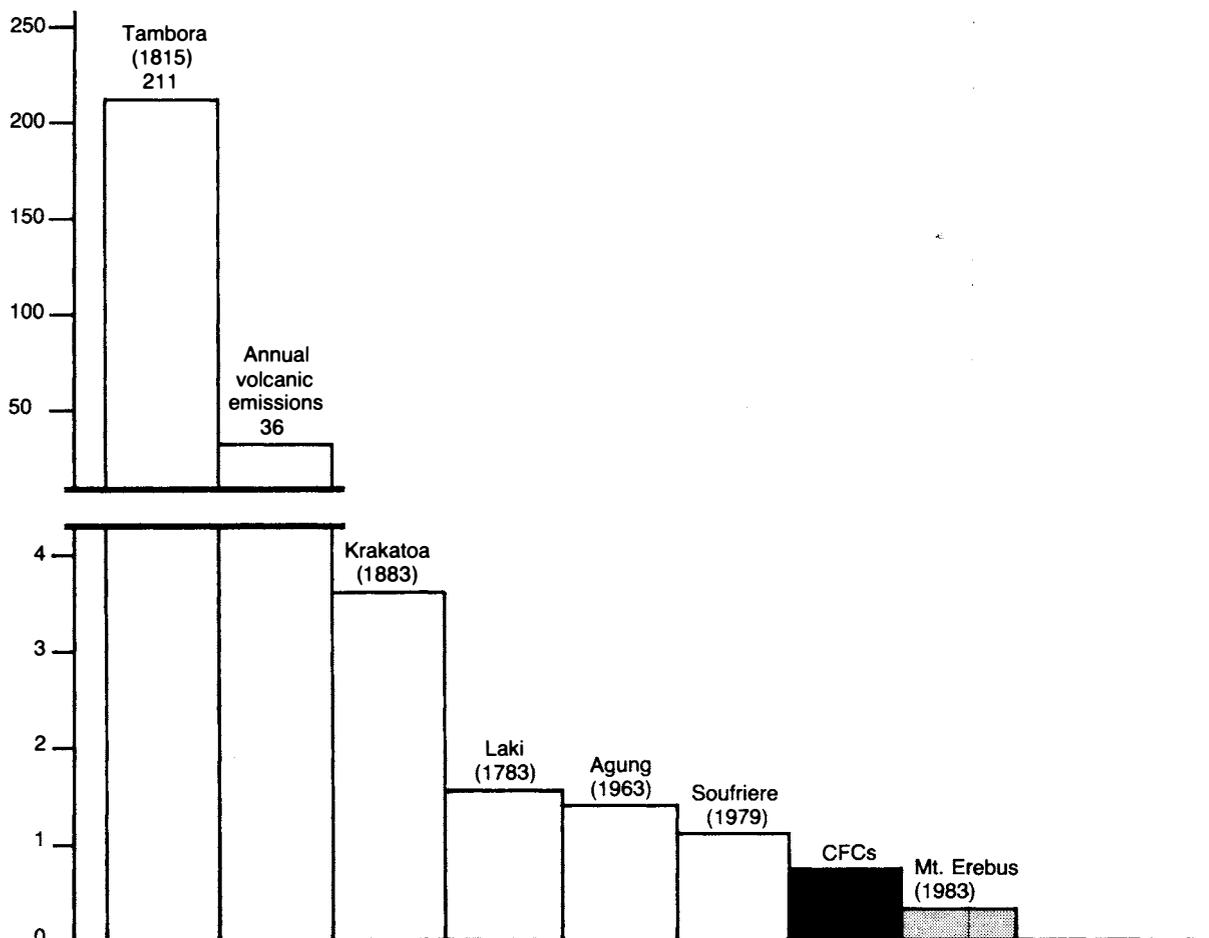
Chlorine gases are very difficult to measure in the atmosphere, so up until the time when Johnston published his work, the chlorine output of volcanoes had been estimated by assuming that magma contains 0.02-0.025% (by weight) chlorine before eruptions, which was all released during the eruption.

Johnston made more careful measurements and found the percentage of chlorine in the magma to be much greater than previously thought. He states, “The richest magma may contain more than 0.5 to 1.0% chlorine, which exceeds by 20 to 40 times or more the earlier estimates upon which volcanic atmospheric impact has been estimated.”

Discussing the effect of volcanoes on the ozone layer and climate, Johnston states, “Geologically major eruptions, such as caldera forming eruptions that emit hundreds of cubic kilometers of magma, may have a long-term impact upon stratospheric ozone. For example, eruption of the Bishop Tuff from Long Valley Caldera, California, 700,000 years ago generated 100 cubic km of air-fall ash. If the magma degassed 0.25% chlorine (equivalent to Augustine Volcano), this eruption may have injected 289 [million metric tons] of HCl into the stratosphere, equivalent to about 570 times the 1975 world industrial production of chlorine in fluorocar-

FIGURE 3
Atmospheric chlorine emitted in one year by great volcanic eruptions compared to chlorine from CFCs

(Millions of tons)



bons. Clearly, volcanic sources of stratospheric chlorine may be significant in comparison with anthropogenic sources." Johnston promised to break new ground in volcanology, but tragically died at his observation post when Mt. St. Helens, Washington erupted in 1980.

The other major ingredient of chlorofluorocarbons is fluorine (F), which is also supposed to be an ozone killer and a super-"greenhouse gas." As with chlorine, however, fluorine is also an abundant natural trace gas. The explosion of Tambora in 1815 put up a minimum of 120 million tons of fluorine in the atmosphere, which, at present rates, is the equivalent of 483 years of production of fluorine in CFCs. Furthermore, the amount of fluorine from passively degassing volcanoes may be as high as 6 million tons a year, which is 24 times greater than the world production of fluorine in CFCs, approximately 248,600 tons per year. Three scientists, Robert B. Symonds, William I. Rose, and Mark Reed, published a paper in *Nature* magazine, Aug. 4, 1988, where they examine the contribution to the atmosphere of chlorine and fluorine bearing gases from volcanoes. After examining the evidence, the authors draw contrary conclusions to the statements of the Ozone Trends Panel, the biggest Chicken Littles about ozone depletion these days, which "suggest that photolysis of anthropogenic halocarbons in the atmosphere is the only major source of atmospheric HF," hydrogen fluoride. Rather, they continue, "This paper supports other work that naturally degassing volcanoes also emit significant quantities of HF, some of which is directly injected into the stratosphere. Thus,

volcanoes should be regarded as a significant source of tropospheric and stratospheric HF."

Chlorine from biomass burning

Up until the late 1970s, the amount of gases contributed to the atmosphere from biomass burning and forest fires was considered minimal, but careful measurement of forest fires since then indicates that they are a major source of gases for global atmospheric chemistry. Biomass burning may contribute more carbon dioxide to the atmosphere than all of man's industrial activities put together. The Brazilian scientist Alberto Setzer calculated that more than 540 million tons of CO₂ were released into the atmosphere by the burning of the Amazon rain forest in 1987. Richard Houghton, from the Woods Hole Institute, had a higher figure based on a different estimate which includes the amount of CO₂ released not only from the burning of the forest, but also by the then-exposed soils: 4 billion tons. So, the burning of the Amazon rain forest, which is less than half of the world's total biomass burning, releases almost as much CO₂ as the entire release of CO₂ attributed to industrial activities, 5 billion tons.

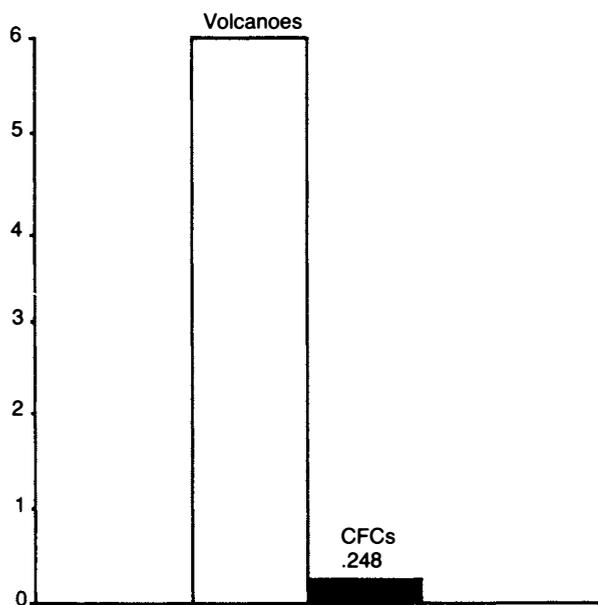
Another gas released by biomass burning includes that singularly evil molecule, chlorine, in the form of methyl chloride (CH₃Cl). According to one of the original papers on the subject, titled "Biomass burning as a source of atmospheric gases CO, H₂, N₂O, NO, CH₃Cl, and COS," 420,000 metric tons of chlorine contained in CH₃Cl were released in 1979 by the burning of biomass. The authors of the paper, Paul Crutzen, Leroy Heidt, Joseph Krasnec, Walter Pollock, and Wolfgang Seiler cautioned, however, that their estimates may be very low. They state, "Note that our estimates on the global extent of biomass-burning, are substantially smaller than those of other workers such as Wong and Woodwell et al. We cannot defend the data compiled . . . here due to lack of space; however, acceptance of higher biomass burning rates will clearly lead to larger estimates of trace gas emission rates."

Since the release of this study in *Nature*, Nov. 15, 1979, the pace of global deforestation, biomass-burning, and slash-and-burn agriculture has increased exponentially, as a result of savage austerity policies imposed on Third World nations by the International Monetary Fund and the World Bank. Therefore, it is not a surprise that recent, more accurate satellite surveys of global deforestation and burning of the tropical rain forests show it to be at least 10 times greater than estimated by Crutzen, et al. That would mean that biomass burning, a result of the same enforced backwardness the environmentalists advocate, is releasing at least 4.2 million tons of chlorine into the atmosphere.

This biogenically generated chlorine, according to Crutzen et al., may pose a serious threat to the ozone layer, since it breaks up in the stratosphere into the same chlorine molecules as CFCs. They state, "The decay of CH₃Cl in the stratosphere releases Cl and ClO, which are extremely efficient in limiting stratospheric ozone by catalytic reactions."

FIGURE 4
Fluorine annually released by volcanoes, in the absence of great eruptions, vs. CFCs

(Millions of tons)



Thus chlorine molecules released by biomass burning contributes at least five times more chlorine molecules into the atmosphere, 4.2 million tons Cl, than the chlorine contained in all the world's yearly industrial production of CFCs, 750,000 tons. (Figure 5)

However, even this figure may be a gross underestimate. Crutzen et al. warn, "Note that in our source calculations for the atmospheric trace gases, we did not consider the potential release from the heating of the topsoil organic matter or from the [4-8 billion tons of carbon] of matter which is exposed to fire but left behind as dead, unburned above-ground biomass. The topsoil organic matter is especially rich in nutrients and may make important contributions to the cycling of atmospheric trace gases and nutrient elements."

(It should be further noted that Crutzen's calculations are based on smoke plume samples taken from forest fires in Colorado. Tropical rain forests have much greater densities of biomass than temperate forests, and thus will release much greater amounts of gases into the atmosphere.)

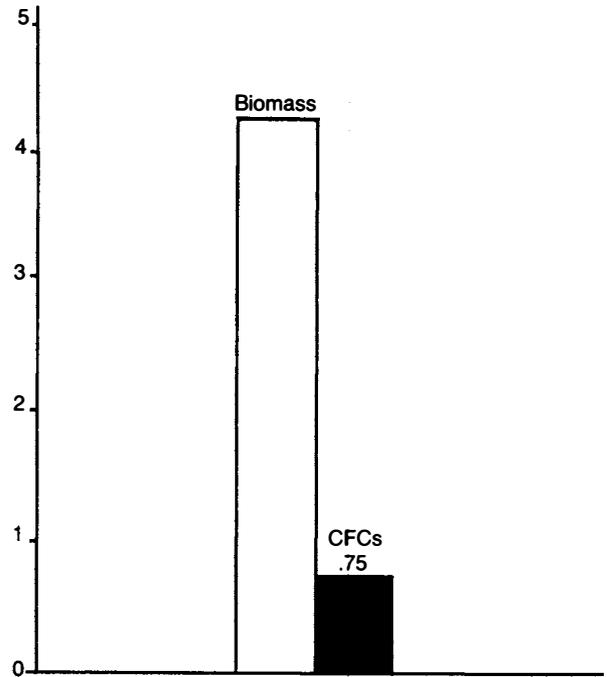
The authors end the article, "Despite the limited amount of observations, we must conclude that biomass burning, especially in the tropics where the rates of biomass production and biomass burning are unparalleled, has the potential to contribute in an important way to the global budgets of several major atmospheric trace gases. We also need to consider that tropical emissions occur in photochemically very active and dynamically important regions in which substantial transfer of tropospheric air to the stratosphere takes place."

The dynamic regions that Crutzen et al. refer to are above the tropical rain forests, but the two greatest are above the Amazon rain forest and the Indonesian Archipelago, which are known as the world's "stratospheric fountains" due to the enormous amount of water vapor and gases transported to the stratosphere by the very violent convective storms in these areas. This is of great importance for the study of chlorine and fluorine transport to the stratosphere, since the greatest amount of biomass burning takes place in the tropical rain forests, and the most active area of volcanism worldwide is located in the area of the Indonesian stratospheric fountain, providing ready transport for volcanic gases to the stratosphere.

The behavior of one of these dynamic regions, the Amazon rain forest, was studied in detail for the first time during a joint atmospheric expedition carried out by NASA and the Brazilian space agency INPE in 1985 and 1987. The results of the scientific expedition, called the Atmospheric Boundary Layer Experiment (ABLE), were summarized by Robert J. McNeal, head of NASA's Earth Sciences and Applications Division, in testimony before the U.S. Congress. McNeal stated, "A mechanism is readily available in the Amazon to transport gases between the planetary boundary layer and the 'free' troposphere, where they can enter into large-scale circulation patterns. Deep convective storms of considerable volume are established with great frequency and move essentially continuously around the basin. Such a storm brings

FIGURE 5
Chlorine annually released by biomass burning vs. CFCs

(Millions of tons)



material down from high in the atmosphere, up to and including the stratosphere, which is a source of ozone [and] also raises material from the top of the canopy to the upper troposphere. The intensity and frequency of these storms essentially couple the surface and the troposphere vertically in the Amazon region."

These violent storms have enormous power., McNeal states, "The magnitudes of convective storm transports have been calculated directly for the first time. Individual convective storms transport 200 megatons of air per hour of which 3 megatons is water vapor releasing 100,000 megawatts of energy into the atmosphere." On average, there are 44,000 thunderstorms every day, mostly in the tropics, producing more than 8 million lightning bolts.

The extensive destruction of the tropical rain forest under the economic policies of the International Monetary Fund is going to have much greater consequences in upsetting the global climate than the imaginary threat from CFCs and other "man-made" pollutants. McNeal warns in his testimony, "Replacing the forest with wetlands or pasture would likely have large impacts on this enormous furnace with attendant large effects on atmospheric circulation patterns and, therefore, climate. Evapotranspiration and rainfall will decrease. The amount of latent heat transported to temperate and polar latitudes might be reduced, and these regions might experience a cooler climate as a result."

Volcanoes and climate

The idea that volcanoes play an important role in climate was first put forward by Benjamin Franklin in 1784. In a paper read before the Philosophical Society of Manchester, England on Dec. 22 of that year, Franklin had observed a reduction in the intensity of sunlight at the Earth's surface during the summer of 1783, and he hypothesized that the volcanic eruption of Laki crater in Iceland at the beginning of the summer had created a "dry fog" which was blocking the sunlight. Franklin then correctly postulated that the severe winter of 1783-84, experienced by the eastern United States and Western Europe, was the result of this reduction of solar intensity, which would prevent the normal amount of summer heating of the Earth's surface to occur.

Franklin's hypothesis was that the high-altitude "dry fog" was formed from the solid volcanic "dust" ejected by the explosive force of the Icelandic eruption. The volume and injection height of the volcanic "dust" ejected during a volcanic eruption are directly related to the explosive force of the eruption, and to the vertical wind structure at the time and the location of the eruption. Since Franklin presented this scientific paper, it has been considered that only the largest, most violently explosive eruptions would produce a measurable climatic impact. These assumptions have been challenged, however, in the past two decades, when direct sampling of stratospheric aerosols began to take place.

In a benchmark paper, J.D. Devine from the Graduate

School of Oceanography of the University of Rhode Island, and several co-authors, challenged the established notions, and backed the idea that sulfate aerosols have a greater climatic impact than volcanic "dust." In their 1984 paper, the authors found a very close correlation between temperature changes on the surface of the Earth and the amount of sulfur released by a volcanic eruption, a correlation they did not find with other material yielded by the volcanic explosion. This study contained detailed examinations of trace gases estimated to have been erupted by several major volcanic eruptions, including chlorine.

One of the major points of the paper, published in the July 10 issue of the *Journal of Geophysical Research*, is that it is not necessary to have explosive volcanic eruptions to put all this material, including chlorine, into the stratosphere so that it affects climate. The paper states, "Although the Laki eruption produced about 0.3 cubic km of tephra (more than the 1980 Mount St. Helens eruption), the eruption was largely nonexplosive. Yet, it is likely that the average temperature decrease following this eruption was comparable to those following the large historic explosive eruptions which are known to have penetrated the stratosphere. This seems paradoxical, because it is commonly assumed that volcanic aerosols released during relatively quiet eruption of basaltic magma would remain in the troposphere. The Laki eruption shows that this may not be the case. It is possible that the thermal structure of the atmosphere over a large lava field such as the Laki field (565 square km) may be perturbed by the heat released from the surface of the degassing magma. Atmospheric convective flow induced over the lava field, together with the explosive (phreatomagmatic) and fire-fountaining activity, would allow a portion of the gases released to rise to the stratosphere, which would be penetrated by the ascending plume of heated air and volcanic gas. We consider this phenomenon as analogous to initiation of free convection of a fluid overlying a flat plate heated from below. Dimensional analysis of the Laki phenomenon shows that the initiated convection must be turbulent rather than laminar. Because the tropopause is low over Iceland (7-10 km), the thermal plume produced over the Laki lava field was evidently able to penetrate the stratosphere and cause a significant, widespread climatic effect in the northern latitudes."

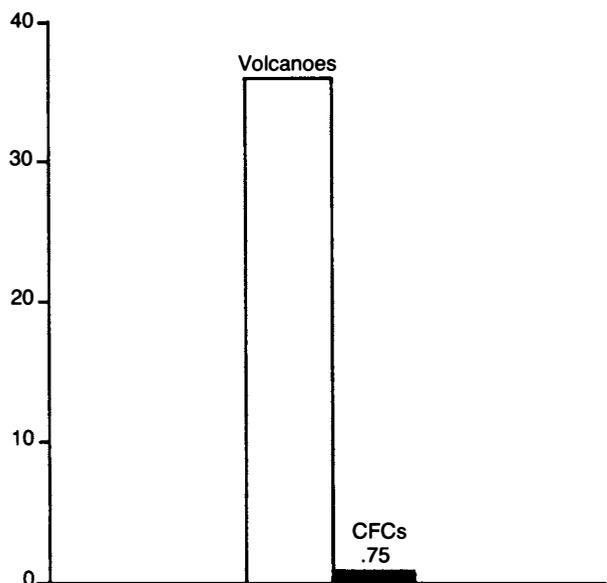
The same year, Brian Goodman, from the Center for Climatic Research at the University of Wisconsin, presented a doctoral thesis which reviews the history of the subject, and presents a thesis that low-intensity volcanic activity also has an impact on the climate through "diffuse" sources of volcanic gases, and that there are harmonic cycles of volcanic activity, influenced by solar and lunar tides, which are reflected in the climate record. Goodman states:

"Volcanic eruptions will indirectly impact the climate system through direct modulation of the atmospheric transparency to shortwave solar radiation. This direct modulation results from an enhancement of the stratospheric aerosol load

FIGURE 6

Chlorine annually released by volcanoes, in the absence of great eruptions, vs. CFCs

(Millions of tons)





Volcanic plume from Mt. Erebus, Antarctica, an active volcano which has been erupting for at least the past 100 years. The scientific observation station at McMurdo Bay is less than 15 kilometers downwind from the volcano, which was measured to be outgassing more than 1,000 tons of chlorine a day into the atmosphere in 1983. This explains the high levels of chlorine gases registered at McMurdo, without the need to claim that CFCs are the source, one of the claims behind present-day hysteria over the ozone layer. The existence of the volcano has been suppressed by the newsmedia, because it blows a hole in the ozone hole theory, since this volcano by itself, in 1983, put almost as much chlorine into the atmosphere as all chlorine in CFCs manufactured throughout the world that year. If it were true that chlorine is destroying the ozone layer over Antarctica, then Mt. Erebus is to blame, not CFCs. Under dry antarctic conditions, the chlorine from Mt. Erebus, over 12,000 feet in altitude, reaches the stratosphere in much greater abundance than chlorine from volcanoes in humid climates.

following the introduction of volcanic material. Two types of aerosols are produced during an eruption: solid tephra [volcanic dust] particles and gaseous aerosol precursors. Before 1970, it was typically assumed that the tephra particles were the principal volcanic contribution to the stratospheric aerosol load. The total volume of tephra erupted into the stratosphere depends upon the violence of an eruptive event. Because of this idea, studies before 1970 only considered the climatic impact of the largest, most violent eruptions, regardless of the eruptive mechanism.

“Direct *in situ* sampling of the stratospheric aerosol layer, or what is often referred to as the Junge layer, following a violent volcanic eruption by both balloon and airplane flights during the 1970s demonstrated that, contrary to what had been previously thought, it was not the solid tephra particles, but the gaseous aerosol precursors which provided the principal volcanic aerosol contribution to the stratospheric aerosol load of the Junge layer. The dominant stratospheric aerosol consists of sub-micron liquid droplets of highly concentrated sulfuric acid. The small amount of tephra particles which have been detected in the stratosphere immediately following a large volcanic eruption decreased to virtually undetectable concentrations within 3-4 months. Rossow (1978) suggests that the tephra particles mix with the tremendous amounts of tropospheric water vapor entrained into the turbulent eruption plume to form large aggregates (i.e., mud balls) which grow rapidly too large to remain suspended.

“The increases in the concentration of the suspended sulfuric acid droplets result from the introduction to the stratosphere of the various sulfide and sulfate gases dissolved in the magma (e.g., SO_2 , H_2S , and SO_4 which are exsolved from the magma at the time of the eruption, and once suspended in the stratosphere, are converted into the sulfuric aerosol droplets through a variety of photochemical conversion processes. More recent studies of the climatic impact of volcanic activity upon the stratospheric aerosol load have included the radiative properties of sub-micron sulfuric acid droplets, instead of sub-micron tephra particles, but have continued to assume that a large volcanic eruption is necessary to directly inject the magmatic sulfur gas emissions into the stratosphere.

“An active volcano will display three major phases of explosive intensity through a complete eruptive episode: violent, moderate, and quiet. An eruptive episode normally begins when the conduit is opened by explosive discharges of the gas-rich top of the magma column. As lower levels of the magma column are tapped, the explosive discharges will diminish in strength to a more moderate level of intensity. The volume of magma and magmatic products discharged during this more moderate phase will not necessarily be reduced. The lower emission rate will be compensated by the longer duration of this phase of activity. Eventually, the explosive activity will cease and give way to the relatively quiet outpouring of lava and effusing of gases through other

related activity, such as fumaroles and hot springs. This final stage of an eruptive episode may remain active for a considerable length of time after the initial explosive phase has subsided. When new magma or magmatic emanations and their reaction products rise towards the surface, explosive activity will be resumed. This new sequence of explosive activity will often overlap the residual phase of the previous eruptive episode.

"Dissolved volatiles within the magma and possible contamination by the local groundwater account for this explosive-quiet pattern most frequently in two different ways. One, heating of the local groundwater by the ascending magma column would lead to steam explosions during the early part of an eruption. As the eruption continued, the groundwater would be pumped away and the eruptive violence would diminish. Two, a vertically stratified magma reservoir could be erupted sequentially. The highest concentrations of water vapor and other volatiles will occur at the top and along the walls of a large magma reservoir. Eruption of the top gas-rich portion would initiate the violent explosive phase, which

would then diminish with time as the eruption continues and draws up magma from deeper and deeper in the conduit. Eruptions resulting from these two eruptive mechanisms are referred to as phreatic or phreatomagmatic and magmatic, respectively.

"Both phreatic (or steam) eruptions and magmatic eruptions can have violently explosive initial phases of activity, and as such could both potentially be identified as large eruptions, and assumed to be climatically significant according to the prevailing theories. It is likely that only magmatic eruptions will inject sufficient volumes of magmatic sulfur gases to have a significant impact upon the stratospheric aerosol load. Phreatic eruptions in their initial explosive phase will produce large volumes of tephra, but very few magmatic volatiles. The extremely violent eruptions of Mt. St. Helens, Washington on 18 May 1980 and of El Chichón, Mexico on 2 April 1982 illustrate the distinction between the impact of the eruption products from the phreatic and true magmatic eruptive mechanisms. The initial reaction of the scientific community with respect to the extremely violent eruption of

Are DuPont, ICI behind 'ozone depletion' scare?

Scientists and chemists interviewed by *EIR* have insisted that they believe that DuPont Chemicals and other chemical giants are behind the "ozone depletion" scare. Evidence for the accusations include indications that a chemical cartel is being created that will have exert total control over the chemicals that will replace CFCs after they are banned. At stake is control over a market for CFCs and related products which could easily total \$120 billion per year in the next decade.

Today, 13 companies worldwide produce the bulk of an annual 1.14 million tons of CFCs. DuPont, which patents its CFC under the brand name Freon, is the world leader, making 25% of the total, with U.S. Allied Chemicals number two, Britain's Imperial Chemicals Industry (ICI) number three with 10%, tied to a French maker, Atochem (Elf Aquitaine). These four companies control about 60% of world supply. Significantly, these same four leading producers are now spearheading the campaign to ban CFC use!

A spokesman for ICI admitted in a recent discussion that ICI is almost finished with a big new plant in Runcorn, Great Britain, which will produce ICI's "ozone friendly" HFC-134a alternative, beginning in 1991. A second plant to make the new chemical is under construction in the

United States by DuPont Chemicals.

On April 28, ICI chairman Henderson told his shareholders, "Our aim is to become the world's leading chemical company." There are some hints as to how ICI plans to do this. Henderson was a key adviser to Prime Minister Thatcher before she chaired the recent London conference on "Saving the Ozone Layer." ICI has come out publicly demanding "complete elimination" of CFC use.

Countries such as Brazil, Taiwan, South Korea, and certain OPEC countries are rapidly developing independent chemical industries which are becoming self-sufficient in producing CFCs and other basic chemicals. "For these large companies, elimination of a few percent in their market share can destroy their entire price structure. These Third World producers have become a serious threat to them on the margins, and that is critical," stressed one London industry analyst familiar with the internal corporate debate. "The ban on CFCs will be a big, big problem for especially Third World countries," he stressed. "The big chemical multinationals want binding legal sanctions internationally to enforce the ban on CFCs. They have invested huge sums in development of alternatives and they aren't about to let Third World producers take this market away from them."

Interestingly, the executive-director of Greenpeace in the United Kingdom, the 41-year-old Lord Melchett, is the heir to the Imperial Chemicals Industry fortune! His grandfather, the first Lord Melchett, Alfred Mond, founded the ICI conglomerate. So, ICI chairman Henderson takes orders from Lord Melchett.



Slash-and-burn agriculture contributes more than 4.2 million tons of chlorine gases to the atmosphere, more than five times the amount of chlorine in CFCs. Over 60% of global deforestation and all biomass burning is the result of policies being pushed by the environmentalist lobby to prevent Third World nations from industrializing.

Mt. St. Helens was that it would significantly increase the Northern Hemisphere stratospheric aerosol load. As it turned out, the eruption was phreatomagmatic in nature, and although it produced vast quantities of tephra, only a small volume of magmatic volatiles were included in its emissions. The anticipated climatic impact from this eruption did not materialize. On the other hand, the extremely violent eruption of El Chichón did emit huge volumes of both tephra and sulfurous magmatic gases to the stratosphere, as did the later more moderately eruptive phases. The sulfur gas emissions which reached the stratosphere resulted in a dramatic enhancement to the stratospheric aerosol abundance and size distribution.

"The total volume of the sulfur gases produced during an eruption is not solely dependent upon the violence or explosiveness of an eruptive event, but upon the combined effect of the rate and duration of eruptive activity, and, of course, on the volatile sulfur content of the magma. A large explosive eruption can provide large volumes of gaseous emissions through high emission rates for short periods of time and inject them directly into the stratosphere, where they are photochemically converted into sulfuric acid droplets. This type of eruption acts as a 'point' source of sulfurous magmatic gases with respect to the stratospheric aerosol load. A more moderately active eruption can produce the same total volume of emissions by compensating for a lower emission rate with a greater duration of activity. In this situation, the gaseous emissions are not directly injected into the strato-

sphere, but are often injected high enough into the upper troposphere that they can remain suspended for several weeks, which will enable some fraction of their original eruption products to be indirectly transported into the stratosphere through one of several stratospheric-tropospheric exchange processes. The stratospheric-tropospheric exchange mechanisms, besides transporting magmatic sulfur gases from moderate eruptive activity into the stratosphere, are also partly responsible for the removal of the converted sulfuric acid droplets from the stratosphere. This indirect entrainment of sulfurous magmatic gases into the stratosphere acts as a 'diffuse' source with respect to the stratospheric aerosol load."

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