SOMETHING IN THE AIR

The effects of charged particles on living systems remain mysterious despite a recent gust of interest in ion research

BY LINDA GARMON

The plunging, white-trimmed streams of the waterfall are mesmerizing, soothing. Some would attribute this effect to visual and auditory beauty; others would add a third factor—the ability of the falling water to spew negative ions into the surrounding air.

The "Witches' Winds" come sweeping down. Called the Santa Ana in Southern California, the Chinook in Canada, the Foehn in Central Europe, the Sharav in Israel and the Mistral in France, the winds are said to come on the heels of an increase in illness, dosmetic quarrels, suicides, murders and accidents. One theory blames this phenomenon on the positive ions that are generated by, but move ahead of, the hot winds.

The Silver Spring, Md., office of Charles Wallach is typical in most respects, with the usual supply of files, paper clips and other office paraphernalia. But in the corner is a small, odd-looking black box that breeds negative ions. Wallach — a member of an American Society for Testing and Materials (ASTM) committee that recently began formulating a standardized procedure for testing ion generators—claims the device rid him of pre-coffee crankiness that once drove family and co-workers away each morning.

The water, the winds, the generator. All have become elements of the great, long-tenured ion mystery: What, if any, are the precise effects of ions on living systems? Intensified attempts to answer that question have set rolling a new wave of interest in ion research.

The first wave was launched at the end of the 19th century when German and English researchers independently discovered the existence of air ions, or positively and negatively charged particles formed in nature by radiation, electrical discharges, short-wave ultraviolet light and the friction of moving water, sand, dust, snow or hail. Shortly thereafter, biologists and physicians began to investigate whether these ions influence physiological processes. Although such investigation seemed to intensify in the late 1950s and early 1960s—a second distinct period in the history of ion research — the only fruits of the effort seemed to be inconsistent data.

Despite this lack of a solid data base, a number of companies appeared on the horizon about this time to manufacture and promote the sale of negative ion generators that owners could use to neutralize the allegedly deleterious effects of positive ions. The devices — which have one or more metal points to produce ions via a corona discharge — were touted as cures for countless medical conditions, including cancer, emphysema, tuberculosis, rheumatism, heart disease, insomnia, depression, stress, weak muscles and learning disabilities. But U.S. Food and Drug Administration officials saw no evidence that these appliances were safe or effective, so they took regulatory action against the manufacturers of nine different brands.

Then, because "people had tried to exploit it commercially before they understood it scientifically, ion research got a black eye," says one investigator in the field. But certain researchers — Albert P. Krueger of the University of California at Berkeley, for example — stuck it out through the ion's darkest days. And newcomers — such as Jonathan M. Charry of Rockefeller University in New York City — have since joined the current wave of investigation. "A lot of people who work in this field are flaky," says Charry, "and a lot of my colleagues at Rockefeller think *I'm* a lunatic for being in it. But I would like to see it become a respected field of science." Because altered ion concentrations can result not only from natural phenomena, but also from the presence of pollutants and high-voltage direct current lines, says Charry, ion research could have significant environmental implications.

Study results may one day identify, for example, an optimal positive-to-negative air-ion ratio for workplace performance. L. H. Hawkins of the University of Surrey in Guildford, United Kingdom, recently toyed with this idea in one particular type of workplace environment — a computer-congested office with many visual display units (VDU's) (also known as visual display terminals [VDT's]).

Such visual display screens usually have positive voltages that leave the near-screen air with a negative ion count of virtually zero. (Researchers estimate that "clean" outdoor air has about 1,000 positive and 1,000 negative "small" ions per cubic centimeter, "polluted" or city air has fewer of each and air-conditioned office air has still fewer — about 100 total ions per cubic centimeter.) To determine whether this unusual dearth of negative ions affects worker comfort, Hawkins installed ion generators in a computer office. When the generators were operating, about 3,500 negative and 100 positive ions floated through each cubic centimeter of office air; when they were shut off, the air in the office averaged only about 550 negative and up to 500 positive ions per cubic centimeter (presumably with little to no negative ions close to the VDU screens). The 54 office employees, 4 of whom were female, did not know whether the generator was operating in each work shift.

Hawkins collected data from short questionnaires given to the workers after each shift. The results suggest that the generators' "negative influence" may have produced some positive effects: A decreased number of headaches, nausea bouts and dizzy spells were reported after generator-on shifts.

In a second study, Hawkins measured subjects' performance on standard tasks under both high negative- and high positive-ion conditions in special test chambers. The subjects, unaware of the ion manipulation, scored significantly higher under the negative-ion situation on mirror drawing and visual and auditory reaction time tests. Hawkins stresses, however, that until the results can be duplicated, both sets of data — which were presented last summer at a Loughborough University of Technology symposium on "Health Hazards of VDU's" — can be considered only preliminary at best. Hawkins explains that several other factors, including intrinsic work satisfaction or supervisory climate, can influence an individual's degree of comfort at work.

And that's just the tip of the flaws-in-ion-research iceberg; several other aspects of study design also may be responsible for the usually inconsistent data generated in this field. For instance, "It is impossible to determine the number of ions actually inhaled in such experiments unless measurements [are] made in the subject's breathing zone," Charry notes. But most important, he says, "Research with humans has been characterized by subject samples in which individual differences in response to air ions were not specified." In other words, explains Charry, "The implicit assumption is that subjects respond uniformly to small air ions."

Quite to the contrary, though, early research on this subject—such as studies in Sharav-plagued Israel—has indicated that only about 30 percent of any given population is ion-sensitive. Therefore, before conducting his recently published experiments on the effects of positive ions on human behavior, Charry first identified which of his 50 male and 35 female subjects he believed were ion sensitive. These he singled out with the aid of the autonomic lability score (ALS).

The ALS — a measure of an individual's ability to adapt to environmental stress — is calculated after the subject plunges one hand into cold water while electrodes record changes in basal skin conductance on the other hand. Using this score as a predictive tool, Charry deemed 34 of his 85 subjects likely to be ion sensitive.

Charry then tested the mood and performance of all subjects in ambient (containing background positive and negative air ion levels of 300 ions per cubic centimeter) and positively ionized (containing between 20,000 and 30,000 positive ions per cubic centimeter) conditions. Study participants were asked to complete a Mood Adjective Check List, a standard instrument designed to assess momentary mood state, and to perform a simple, button-pressing response-time test under both conditions.

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The results — published in the July 1981 JOURNAL OF PERSONALITY AND SOCIAL PSYCHOLOGY—indicate that while positive ions had no effect on the reaction times of non-sensitive subjects, those subjects judged ion-sensitive experienced slower reaction times during positively ionized sessions. In addition, report Charry and Frank B.W. Hawkinshire V of New York University, "For most subjects, mood changes induced by [positive] ion exposure were characterized by increased tension and irritability."

Are there measurable physiological effects of small air ions associated with such observed behavioral effects? That's the $64,000 question in ion research, and for now, no clear-cut answers are emerging. Previously, limited data indicated that altered ion concentrations can alter concentrations of serotonin — an important neurotransmitter. Serotonin imbalance has been implicated in various behavioral disorders such as hyperactivity and aggression. Krueger, Marian C. Diamond and colleagues found that high concentrations of positive ions raise the serotonin concentration in the blood of rats, whereas similar concentrations of negative ions lower it. However, the researchers — whose study was published in the Nov. 7, 1980, SCIENCE — also found that ions of both polarities decrease concentrations of *brain* serotonin in rats.

"Not only are these data limited," says Charry, "but regional analysis of serotonin activity in brain has not been carried out, and examination of other behaviorally relevant biogenic amines [a class of neurotransmitters] has not occurred." Present work in his laboratory is focused on obtaining such data. Specifically, Charry and colleagues are measuring in rats the effects of a high concentration of positive air ions for two time periods (6 and 18 hours) on the concentrations of three related neurochemicals (serotonin, norepinephrine and dopamine) in six specific brain regions (hypothalamus, hippocampus, striatum, locus coeruleus, frontal cortex and brainstem). Preliminary data from the ongoing research indicate that high concentrations of small positive air ions have no effect on norepinephrine and dopamine concentrations. (Serotonin levels still are being analyzed.)

Ask Charry whether ion generators can affect living systems, and he answers: "I don't know what to believe — honestly. Look at my studies with humans and see big, peculiar effects. Then look at the rat studies and all of a sudden, nothing is happening. Frankly, I just don't know."

Moreover, Charry doubts that ion generators can even deliver what current ads promise: clean, sparkling air. "The claim is made that ion generators charge and ground pollutant particles," he says. "But there are billions and billions and billions of particles per cubic centimeter of air...and what a negative ion generator can ionize is only about a million of those. So it's not even an efficient way to clean the air."

But ion-generator advocate Wallach insists that the small amount of particles affected is totally irrelevant — pheromones operate effectively at low levels, he says, so why not negative ions? He believes the only immediate solution to the problem of entrapped pollutant aerosols is zapping them with negative ions. This he reported at the recent International Indoor Air Pollution, Health and Energy Conservation symposium in Amherst, Mass.

"I was dragged kicking and screaming into this ion game as a total disbeliever," Wallach later told SCIENCE NEWS; now, however, he firmly believes in the positive health effects of negative ions. Wallach had coughed and sniffled his way through the interview. "I don't have a cold," he assured this reporter — "I have a scratchy throat for some reason or another."

"Oh," he quickly blurted out: "My negative ionizer is unplugged." □