

ARSENIC,

a known cancer-causing agent in cigarettes

THERE IS ARSENIC in most of the cigarettes smoked to the number of four hundred billions each year by about 50 millions of American smokers. The tobacco in nine leading American brands of cigarettes tested recently was found to contain 5 to 23 parts per million of arsenic.

Everyone knows that arsenic is poisonous; it is a favorite lethal agent for the skulking, scheming murderers in crime fiction. Devotees of murder mystery novels know also that arsenic has a *cumulative* effect. Repeated doses add up. Illness or death can come after an extended period of exposures to quantities so small that any one of them alone would not have a noticeable effect. Arsenic, unlike some poisons, is not promptly excreted without lasting effect, but is deposited in the body, especially in the kidneys, liver, intestinal walls, skin, spleen, lungs, hair, and bones. It can be transmitted to an infant through the placental circulation or through the mother's milk.

Arsenic is the only material thus far found in cigarettes which is *known* to be capable of inducing cancer in human beings. Other chemicals from cigarettes, notably benzpyrene, are carcinogenic (cancer-inducing) for some animals, and are strongly suspected, with good reason, of having this property for man also—but arsenic is known certainly, on the basis of much clinical evidence running to hundreds of cases, to be a cause or a co-cause of cancer in men. As with X-rays and other ionizing radiations, the cancerous growths triggered by exposure to arsenic may sometimes appear after a delay of many years.

Of the arsenic present in the smoked portion of a cigarette, about one eighth is drawn into the smoker's body, according to the results of research reported by two scientists of the U. S. Department of Agriculture. This means that a heavy smoker—consuming two packs a day—of some American cigarettes may well be taking into his mouth and lungs about 90 micrograms (nearly one tenth of a milligram) of arsenic daily. While medication with an arsenical compound was once very common (Fowler's solution), inorganic arsenic preparations are no longer official in the U.S. Pharmacopeia. Medical men nowadays make only very limited use of arsenic, and only in a very few highly dangerous diseases where the risk of injury seems to be worth taking are arsenical medications used, for a limited period and under close professional observation and supervision. According to the work of M. Daff and E. L. Kennaway in England, a person who smokes 50 cigarettes with a mean arsenic content of 50 micrograms has volatilized as much as one fourth the amount contained in a minimum "official dose" of Fowler's solution.

The size of a single dose of arsenic that will kill a human being is fairly well known. The amount that can be tolerated in a series of small doses without producing the classic symptoms of "chronic" arsenic poisoning is less well established, but poisoning has occurred with as little as 2 to 4 milligrams (2 milligrams is about 1/250,000 pound) of arsenic daily for a year or two, and as

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ARSENIC in cigarettes

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little as 20 milligrams in a single dose has proved fatal.

Very little is known as to what small amount might be taken in daily without risk of arsenic's cancer-causing effect after 10, 20, or 30 years. It may be, of course, that lung tissue is far more sensitive to the action of arsenic than other parts of the body.

No one knows what portion of the 90 micrograms of arsenic that a heavy smoker of American cigarettes may draw into his body each day will remain there and what portion will be expelled with the exhaled part of the smoke. And no one knows what daily dose would be large enough to trigger the changes in exposed cells that may, after many years, become a cancerous growth. Lacking, too, is the knowledge of the extent to which arsenic may contribute, along with various other highly poisonous and irritating substances in cigarettes, such as benzpyrene, to bringing on a cancer that might not have originated if the body had been exposed to arsenic alone. It seems probable, since death rates from lung cancer are much higher in cities than in rural areas, that the combination of atmospheric pollution by smoke, dust, and fumes, with cigarette smoking, triggers that dreaded and usually fatal disease.

In any event, about one man in ten over 25 who smokes more than 20 cigarettes a day—about the average number consumed by American smokers—will contract lung cancer by the age of 75. A person smoking two packs a day has a 70 times greater chance of developing lung cancer than a non-smoker; one in 8 to 10 men smoking that much can expect to die of lung cancer.

When arsenic is the homicidal material in a story of crime, it often turns out that the deadly substance was filched from the "gardener's shed" where it was kept for making up insecticidal plant sprays. It is this use of arsenic for field crops that probably also accounts for the contamination of cigarette tobacco. Arsenical pesticides were used for many years in the tobacco fields. Although these materials are believed to be no longer in extensive use, the soil seems to have retained from repeated drenchings with the powerful bug-poisons enough arsenic to account for the amounts found in cigarettes. (In some orchards in the Far West, the soil became so impregnated with arsenical insecticides that the fields had to be abandoned as useless for the growing of crops; arsenical soil poisoning in tobacco growing areas has also been a factor of serious consequence to growers.)

ARSENIC CONTENT OF CIGARETTES

in micrograms of arsenic per gram of cigarette*
(excluding filter tip, if any)

AMERICAN BRANDS (in alphabetical order)

Camel.....	15
Chesterfield.....	19
L & M.....	23
Lucky Strike.....	19
Marlboro.....	10
Pall Mall.....	15
Philip Morris.....	20
Viceroy.....	5
Winston.....	17

NEAR-EAST BRANDS

Abdullah & Co., Ltd., "Turkish No. 11"....	.01
Ed. Laurens, "Le Khedive".....	none
Hellas No. 1.....	none

* A "regular" size cigarette weighs roughly one gram. A microgram is one millionth of a gram; a gram is about 1/28 of an ounce. NOTE: For these determinations of arsenic content, the cigarettes were pre-treated or "digested" in acid in accordance with a method developed by C. C. Cassil of the U. S. Department of Agriculture. Some investigators have reported that another technique involving combustion in a closed bomb shows that cigarettes contain even larger quantities of arsenic. (Some is said to be lost in the acid-digestion process of analysis.)

The substitution of other materials for arsenicals once generally used to spray tobacco fields was begun in 1946. Nevertheless, it is apparent that tobacco plants grown in these fields 11 years later absorb appreciable amounts of arsenic. As a matter of fact, there is no noticeable reduction as time passes. Cigarettes analyzed for Consumers' Research in 1934, 1936, and 1938 showed arsenic contents which in many cases were of the same order of magnitude as were found in the current tests. When, if ever, through the operation of natural causes, the soil may become free of arsenic to the extent that tobacco plants do not absorb it is not known. It is at least possible, though we think it unlikely, that means may be devised to decontaminate the fields, to prevent the plants from absorbing arsenic, or to remove the arsenic from the tobacco before it is used or even to provide means that will filter most of the arsenic from tobacco smoke. This problem is one of a number of very serious responsibilities of the tobacco industry, which has shown an astonishing lack of interest in arsenic as a carcinogen.

Fortunately, for smokers who can be choosy about their cigarettes, tobacco grown in some

places outside of North America seems to contain little or no arsenic. Tests of cigarettes made from Greek and Turkish tobaccos showed amounts of arsenic that seem negligible by comparison. *English* cigarettes are likely to be made from "Virginia" tobacco and published reports indicate that the arsenic content is comparable to that in the American product.

Consumers' Research would be happy if it could simply advise readers who smoke cigarettes to choose those made from relatively arsenic-free tobacco grown in the Near East. This would be good advice if it were certain that arsenic is *the* cause or a major cause of the well-established relationship between smoking and cancer of the lung. It seems good advice in any event for heavy smokers who are unwilling to give up their addiction, but would like to diminish their rather severe chances of acquiring lung cancer in later life. (It is estimated that 80 percent of the lung cancer that exists—there are 30,000 new cases a year—would not occur if there were no smoking.)

In any event, it seems possible that arsenic may not be the *only* cancer-causing material present in cigarette smoke. But Consumers' Research can say that arsenic was found in samples of various brands of cigarettes as shown in the table. Since arsenic is *known* to be a cause of cancer in human beings, a consumer who chooses to safeguard his health to the extent that is reasonably possible will wish to give serious consideration to these facts.

It is recommended that medical men and scientists who are interested in the brief outline of the subject in this article should read the comprehensive treatment of arsenic as a factor in cigarette smoking in the paper "The Problem of Arsenic in American Cigarette Tobacco," by Dr. Henry S. Satterlee, published in the *New England Journal of Medicine* for June 21, 1956.

Dr. Satterlee is not only an able physician and physiologist but a leading expert on analysis of tobacco for minute quantities of arsenic and the association of arsenic with the types of hydrocarbons believed to have cancer-causing effects. He developed precise techniques of chemical analysis of biological materials for arsenic in very small quantities. In the paper cited, he reports that one group of authors examined 13 patients with uterine cancer and found in their tumor tissues 25 times more arsenic than was found in the circulating blood of the same patient, and 100 times more than is found in normal tissues. This does not conclusively incriminate arsenic as the cause of cancer but pretty clearly suggests that it might be a factor in the causation of the most common type of lethal cancer in women. Because of smokes and dusts produced in various industrial processes, arsenic is present in surprisingly high amounts in the dust in urban homes. In one test of city air, arsenic was found to run as high as 290 to 2700 parts per million. So high a degree of contamination with arsenic is, of course, serious and disturbing.

BrewMaster electric teapot

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again from the stigma attached to the words "Made in Japan" in earlier years. Japan's industries, particularly those industries which relate to electrical equipment, where there is the possibility of shock hazard, should at once set up an organization to control the quality and safety of appliances before they are shipped abroad, with particular attention, of course, to the design features such as those of the teapot which offend several sound principles of good engineering. It is, of course, necessary not only to control design, but also workmanship on individual products coming off the production line; each should be properly inspected and tested for electrical and mechanical safety. The Japanese have set an excellent example in the camera industry by the excellent inspection system which they have ap-

plied in their competent and effective Japanese Camera Institute. This Institute provides for proper inspection and tests to see that all exported cameras and binoculars which bear its seal are of good quality that will bring credit rather than discredit to Japanese products. The Underwriters' Laboratories' seal or label should be looked for on all electric equipment and devices for home use, and until this appears on Japanese and other foreign-made devices, it would be better to confine purchases to American-made products of known manufacturers who meet the requirements of *UL* specifications.

C. Not Recommended

Electric BrewMaster (Made in Japan) \$1.99 to \$3.50. Marked OMSCO on bottom of pot. Electrically unsafe.