Protokoll der Hauptversammlung der Schweiz. Gesellschaft für Präventivmedizin in Basel, Samstag, den 25. Mai 1957

Traktanden

1. Protokoll der Hauptversammlung 1956
2. Jahresbericht des Präsidenten
3. Jahresrechnung und Revisorenbericht
4. Festlegung der Mitgliederbeiträge für 1958
5. Mutationen im Vorstand
6. Bericht des Redaktors

Das *Protokoll* der Hauptversammlung wird genehmigt.

Der Präsident orientiert über die *Tätigkeit der Gesellschaft* im abgelaufenen Jahr. Im Mittelpunkt der Bemühungen standen die Vorbereitungen der Veranstaltungen 1957:

1. *Symposium über Hygieneunterricht in Schulen* (in Zusammenarbeit mit der Weltgesundheitsorganisation); 2. *Vortragstagung über die Probleme der Chemikalien in Luft, Wasser und Nahrung* (unter Beiziehung von Referenten aus den USA und Deutschland); und 3. *Symposium über die Fragen der sexuellen Erziehung der Schuljugend.* Der Vorstand hat grundsätzlich beschlossen, in Zukunft die Tätigkeit der Gesellschaft durch die Organisation von Symposien und Diskussionstagungen auszudehnen, um so der Verbreitung des Ideengutes der vielfältigen Gebiete der Präventivmedizin zu dienen. Im abgelaufenen Jahr ist außerdem, zusammen mit der Gesellschaft Schweizerischer Schulärzte, ein Merkblatt über das Rauchen gedruckt worden und gelangte diesen Frühling an alle aus den Schulen austretenden Schüler in der Schweiz zur Verteilung. Unsere Gesellschaft hat außerdem eine Aktion zugunsten der Einführung eines Hygieneunterrichtes in Schulen begonnen. Aus dem Erlös des Pro-Juventute-Markenverkaufs hat die Direktion der PTT für diese Aktion einen Betrag von Fr. 89 000.– zur Verfügung gestellt.

Die *Jahresrechnung* der Gesellschaft und des Aufklärungsfonds wurde einstimmig genehmigt und dem Kassier Decharge erteilt. Die Jahresrechnung 1956 weist ein Defizit von Fr. 3865.– auf, so daß das Vermögen der Gesellschaft um diesen Betrag abnimmt. Der Ausgabenüberschuß muß im wesentlichen auf die Erhöhung der Druckkosten der Zeitschrift und auf eine Abnahme der Inserateneinnahmen zurückgeführt werden. Der Aufklärungsfonds weist keine wesentliche Änderung auf und beträgt Fr. 16 504.–. Um in Zukunft Budget und Jahresrechnungen wieder ins Gleichgewicht zu bringen, sollen die Seitenzahl der Zeitschrift reduziert werden, die Autorenhonorare wegfallen und die Mitgliederzahl erhöht werden.

Auf Antrag des Präsidenten hat die Hauptversammlung ferner beschlossen, die *Mitgliederbeiträge* ab 1958 wie folgt festzusetzen:

a) Kollektivmitglieder	**Fr. 50.–**
b) Einzelmitglieder	**Fr. 20.–**
c) Abonnementspreis der Zeitschrift für Personen, die einem Kollektivmitglied angehören	**Fr. 15.–**

Auf Antrag des Vorstandes sind Herr Dr. med. Th. Müller (Basel) und Herr Dr. med. Ch. Bavaud (Genf) neu in den Vorstand gewählt worden.

Herr Dr. med. R. Egli gibt einen kurzen Überblick über seine Redaktorentätigkeit. Mehrere Mitglieder geben ihrer Befriedigung über die Qualität der Zeitschrift Ausdruck.

Problems of Air Pollution in Great Cities [1])

By *Philip Drinker*, Harvard School of Public Health, Boston 15, Massachusetts U.S.A.

Population Pressures and Air Pollution

Air pollution is a problem of population growth. It is a mundane affair. It is caused by the commonplace and not by the unusual. It is no special bother in the village but when the village grows into a town, even of moderate size, pollution troubles can begin. One cannot relate population density and air pollution in mathematical terms but a relationship is implicit in a world of factories, mines, railroads and motor cars.

You may think of us in the United States as having plenty of room to expand and you may imagine that we are still blessed with abundant natural resources. In 1956 we had a population of 164 million which gave us a population density of 54 per square mile.

If we compare northeastern United States (New York, New Jersey, Pennsylvania, and the New England States) with England and Wales and with Switzerland, we find Britain's population density is 764, ours is 251, and yours in Switzerland 264 persons per square mile. Obviously our heavily industrialized areas are approaching yours and Britain's in the vital matter of population pressure.

The Demand For Energy

A strong trend towards mechanization was evident in Britain early in the 19th century. As it increased it brought about the industrial revolution. There followed a demand for mechanization and for having machinery do the various things which formerly required man power or animal power. Some of this energy was obtained from water power. Most of it came from burning fuels, wood, coal, gas, and peat. To them we have now added petroleum and natural gas.

The demand for power is steadily increasing. It is estimated [1] today that it is close to 3 per cent per annum which must be compounded. It presages the essentiality of new sources of energy from the sun, the tides, the wind, and now from atomic fission.

Putnam [1] estimates that the energy demand in 1960 in the United States will be 32 per cent for comfort heat (heating and cooling), 11 per cent for process heating, and 57 per cent for work heat. The trend in the United States is towards the use of substantial amounts of energy for cooling in hot weather. This new demand for energy is certain to increase.

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[1]) Taken in part from the Harben Lectures before the Royal Institute of Public Health and Hygiene, London, May 13, 14, 15, 1957.

In Figure 1 are shown the trends in the various fuel sources for the past 100 years in the United States. Britain's is not very different. Bituminous coal is still our most used fuel. Wood has gone from the most used to the point where it is about even with oil and gas together. Burning of farm wastes, or converting them into fuels such as alcohol, will probably decrease in importance as the trend in agriculture is to return farm wastes to the soil as fertilizer. Note the comparative unimportance of hydroelectric power in terms of the total.

We will generate power soon from reactors now being built and no doubt Switzerland will do the same thing. We have no alternative.

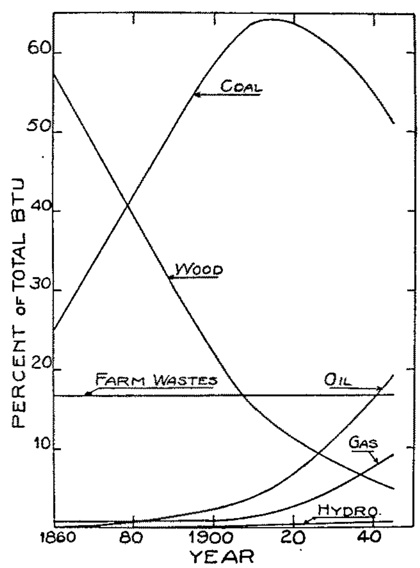

Fig. 1. The fuel resources of the United States [1]

The pollution problems from atomic power do not appear to be one bit worse than those we now have, probably they are really much less. In the event of a disaster, such as a direct hit from an enemy bomb or a bad fire, the prospect of fairly wide contamination by "hot" gases and particulates is not inviting. But there has been no new development in the history of industry that has so effectively kept ahead of its problems in public health as has the atomic energy industry. In describing the safety precautions and general safeguards on the Nautilus, our new atomic submarine, *Ebersole* [2] remarks that the plans are "fool-proof until a fool comes along". I suppose something of the sort applies to the projected power plants. There certainly has been no indication of neglect or failure to consider fully the possibilities of atmospheric pollution in normal operation.

Temperature Inversions and Air Pollution

Under normal conditions temperature decreases with altitude at about 0.65°C/100 m. Not infrequently—and especially in mountainous areas—temperature increases with altitude by as much as 1°C/100 m. Such an occurrence is called a temperature inversion.

Fig. 2. Box Hill, Surrey, England looking towards Ranmore Common (Altitude 200 m.) during the fog of 1952. (Photograph by A. F. Kersting, London.)

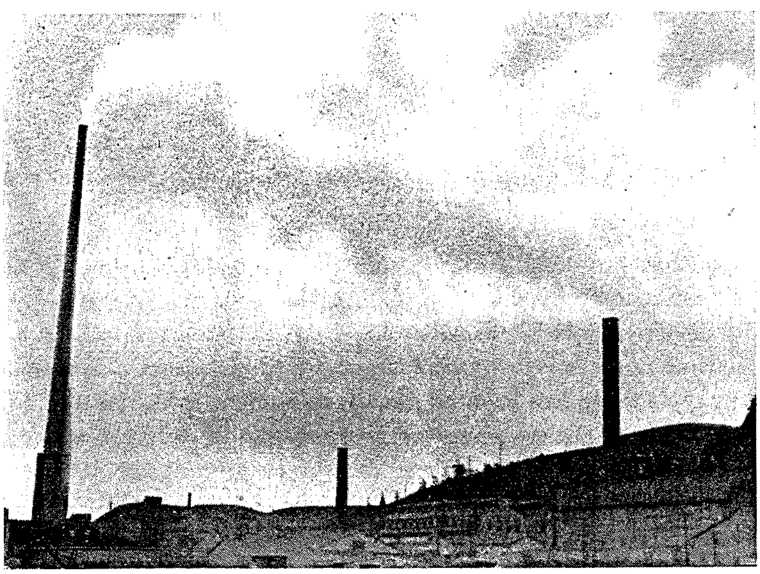

Fig. 3. Smelter stacks at Selby, California showing discharges going in different directions. Stacks are approximately 100 and 200 m high. (Courtesy Messrs. Olson and Abersold, American Smelting and Refining Company.)

There is nothing inherently unhealthy in the inversions. They are a normal meteorological event, but if they persist they can lead to something akin to a lid or ceiling at altitudes of anything from 0 to about 1200 m. In an industrial area the inversions can become a real nuisance.

In 1924 *Shaw and Owens* [3] made tests to determine the lower limit or "ceiling" of inversion layers over the Croyden aerodrome (near London) during a severe fog on December 10th and 11th. On the first night their test kite came into brilliant moonlight at 100 m. A little later the inversion layer moved up to 160 m. and then to 300. At the same time the temperature at Kew Observatory was 1 °C and persisted up to 100 m. At 125 m. it had risen to 7 °C and so remained up to 400 m. when cold air was encountered.

During the 1952 fog in London the photograph shown in Figure 2 was taken rather by chance and shown in the London Times. Ranmore Common is only 200 m. above sea level yet is obviously above the fog. At other places the ceiling was sometimes higher and sometimes lower. In their preliminary report on this fog *Douglas and Stewart* [4] state that it "was thickest in the London Basin in which visibility over large areas was below 20 m. for many hours on end and was often below 3 m."

In Figure 3 are shown two tall stacks from the Selby Smelter, on the northeast corner of San Francisco Bay, California. The lower stack is about 100 m. high and the taller one about 200. Note that the smoke plumes are moving in almost opposite directions. The photograph shows that one cannot predict from ground air movement what the air currents will be at the top of high chimneys. It has become usual, therefore, in designing power stations, smelters, chemical works, and the like to study carefully the air currents at different heights and design the effluent stacks accordingly.

Lethal Fogs

Since 1930 there have been three prolonged fogs in heavily industrialized areas[1]. All of them caused a sharp rise in mortality and morbidity from respiratory illnesses such as bronchitis and asthma, while the adverse effects upon persons suffering from cardiac disabilities was marked.

The Meuse Valley Fog

The fog responsible for this episode lasted from the 1st to the 5th of December, 1930. It covered most of Belgium, but was at its worst along the Meuse river from Huy to Liege, a distance of about 22 km.

[1]) Dirty, wet fogs in London were called "Smogs" by Dr. Des Vœux who first suggested this new word in 1905.

It was characterized meteorologically by persistent anti-cyclonic conditions, high atmospheric pressures and a feeble wind mostly from an easterly direction; that is, it was blowing upstream from Liege along the valley towards Huy. The inversion ceiling was estimated at about 90 m. above the ground. The hills to the south of the river are only about two hundred meters high so that the top of them was probably above the inversion ceiling. It is remarked in one report [5] that it was customary for the farmers in the area to drive their cattle up into the hills to escape severe fogs.

Firket [6] reviewed the results of a public inquiry which was held immediately after the fog abated. A large number of people were injured by the fog. Several hundred were reported to have been severely attacked with respiratory trouble; 62 died on the 4th and 5th day of December after only short illnesses. Many head of cattle had to be slaughtered. Just as we noted later at Donora, Pennsylvania, the fog disappeared rather suddenly and with it went the severe respiratory trouble.

Firket commented on the symptoms of those made ill by the fog as follows:

"All felt a retrosternal pain spreading along the edge of the ribs; they all had fits of coughing, dyspnea of a paroxystic and expiratory character such as asthma, or real polypnea.

Among those in whom asthma was particularly severe, the respiratory troubles were complicated by cardiovascular collapse, marked by a rapid pulse, pallor, cold extremities, profuse perspiration and sometimes, dilation of the heart. In the sick, whose respiratory troubles did not consist in attacks of asthma, but in quickening of the rhythm of breathing, cyanosis was observed, as well as tendency to frothy sputum."

Some 15 autopsies were performed and gave about the same findings as in autopsies following the London fog of December 1952.

Firket remarked "that the public services of London might be faced with the responsibility of 3200 sudden deaths if such a phenomenon occurred there". Then he closes with a nice tribute on the "social and hygienic importance of questions connected with atmospheric pollution. In that field Great Britain is really the leading country".

The Donora Fog

The city of Donora, population 13,000, is located on a sharp horseshoe bend of the Monongahela River 45 km. south of Pittsburgh, Pennsylvania. On both sides of the river are hills rising about 100 to 200 m. with farmland and woods in all directions. Coal barge traffic on the river is heavy. The Donora mills run the full length of the city, or about 5 km.

The fog became dense on Tuesday morning, October 26, 1948. The weather was raw, very calm, with unusual atmospheric stability continuing through Saturday the 30th. By Sunday morning, the 31st, the fog was gone.

There were 20 deaths directly attributable to the fog. How many more were made ill and recovered is hard to estimate but certainly many. The sequence of events, the age distribution of those killed or temporarily made ill, and their symptoms were very much the same as at Meuse Valley and later in London [7].

There were many damage suits brought against the steel company and I was one of a group of technical men retained to contest the suits. The company's officials were Donora residents with a very strong sense of community responsibility. They had banked the fires in the mills on Saturday morning to eliminate any contribution they might be making.

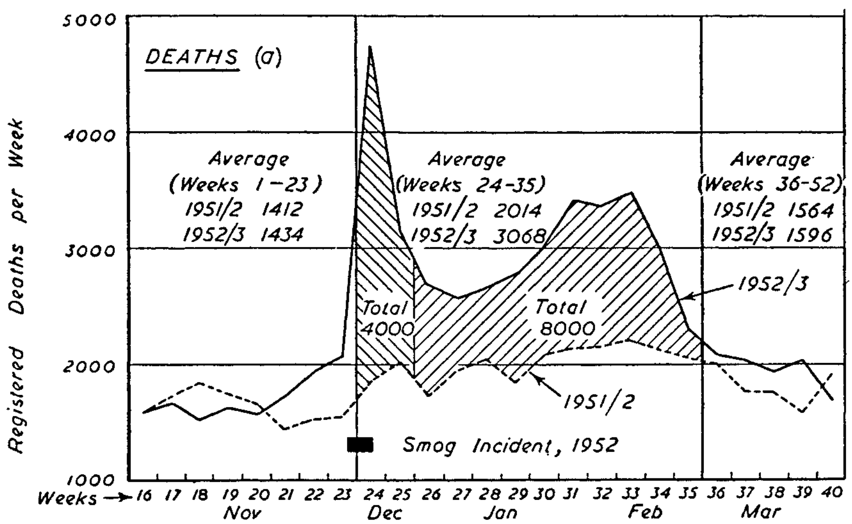

Fig. 4. Mortality in London and environs before, during, and after the fog of 1952. [9]

Late that afternoon, the last day of the fog, it began drizzling. One doctor remarked . . . "The air was different. It did not get you anymore. You could breathe." Another doctor had an urgent call at noon Saturday but could not get to his patients until evening. "I never saw them", he reported. "The landlady yelled up to them that I was there and they yelled right back 'Tell him never mind, we're OK now'." Another doctor reported that "the fog was as nasty as ever early Saturday night but all of a sudden the calls just trickled out and stopped" [8].

Although the chemical or etiological factors in this fog are still, after nine years, unproved there is good reason to believe that heavy industrial activity, especially by the steel mills was an important contributor. If a prolonged fog is forecast by the Weather Bureau all industrial activities which can possibly contribute to pollution will be curtailed promptly. The situation is perhaps a good deal like that of the Meuse Valley where the same sort of preventive program is needed.

The London Fog

From the public health standpoint, the fog of December 5–8, 1952 was the worst London has ever had. It caused the death of some 4000 within the week and of about 8000 more shortly after [9] (Figure 4). The incident was recognized immediately as a disaster. As the British had been taking air samples in London routinely for some years, they were able to present to the world their charts correlating air pollution and disability before, during, and after the fog. Later they published in detail admirable technical reports on all aspects of this episode. In the last five years they have made immense progress in controlling their pollution and their reports have become an authoritative guide to the rest of the world.

Grandjean [10] showed (in this journal) a chart illustrating the striking relation between increase in concentrations of SO_2 and smoke (filterable particles) and deaths in the London Fog. These impurities did not rise to the levels we find occasionally in industry, but they persisted for almost four days, while industrial exposures seldom exceed a few hours.

The British insist on SO_2 control in their power plant effluents and have made great strides in the use of "smokeless fuels" in domestic heating. Their belief in the essentiality of SO_2 control has spread and you will find that the petroleum producers every where are now tending towards de-sulphuring their crude oils from which both furnace oil and motor fuel is produced.

Pollution by sulphur dioxide became a problem in Germany about 1900 in a comparatively small area in which sulphurous copper ores were smelted. They showed that vegetation was even more sensitive to the ill effects of this gas than is man. A few years later America and Canada were smelting non-ferrous sulphide ores on a much larger scale. In the last 20 years, sulphur dioxide has become a useful by-product and is now, in large measure, captured and converted into sulphuric acid. It is in that form that it is used on an ever-increasing scale by the chemical, the petroleum and the steel industries.

Air Pollution in Los Angeles, California

The problem here is quite different from that in London, Donora, or Meuse Valley. It has been getting steadily worse since about 1944 but there has been no lethal fog like those cited. The general health record of the Los Angeles area is comparable to the best we have in the United States.

In 1910 the population of Los Angeles County was about 300,000; in 1940 it was 3 million and now is almost 6 million with indications that the present rate of growth will continue for the immediate future. The city has suffered from the ills that go with rapid growth but has always been vigorous and forward-looking, chided by the rest of us for its fads, its lush vegetation, and its pleasant climate. It has attracted many who moved there to spend their retired years, but the vast majority came for the very human incentive of attractive opportunities to earn their living.

In the last 25 years it has changed from a community predominantly rural to one of the largest petroleum and chemical centers in our nation. At no point in its development has it had much in the way of electric railways or commuting service in and out of the city. Today it seems to be irrevocably committed to the motor vehicle as its primary source of transportation.

The city is in an enormous basin ringed about with high mountains. Over this huge sub-tropical area the inversion is present practically every day during the warm months and frequently during the rest of the year. This is merely part of the total inversion which extends upwards some 400 meters along the coast of California and to as high as 2000 meters over the Hawaiian Islands. Considering the vastness of the area, the enormity of the atmospheric volume involved, and the persistence of the condition, there is nothing man can do but accept it and control the pollution which it can accentuate.

Their bad smogs are eye irritants even to the point of making one's eyes smart and water. Like smogs in London, they bother the asthmatics. This is most apt to occur in the busiest part of the city, and on days when visibility may be sufficient for airplane traffic to proceed normally. The smog will usually be at its worst around noon. It travels eastward by gentle breezes, towards the mountains to the north and the northwest, and then goes back out to sea at night.

An important feature is the fact that smogs damage vegetation.

The smog irritant is now strong enough to make some people move out into the country. Many remember ten or fifteen years ago when they had no such bad eye irritant; protests have been mounting in vigor and in acrimony. Undeniably it is affecting the people's way of life and in a land of plenty this is not to be endured with equanimity or complacence.

None of the common inorganic pollutants gave a clue to this trouble. It was usually less on Sundays and Holidays than in the middle of the week. It was worst around noon, decreased at night, and virtually was absent in the early morning. It was worst in the middle of the city. It was not sufficiently disabling to affect the morbidity statistics of the community. One fact emerged repeatedly, the smog intensity followed closely man's activity and the population density.

By 1950 *Haagen-Smit* et al. [11, 12] had begun to unravel clues to the trouble. Their first effort was to learn to make typical smog in the laboratory so they could study its effects on plants, on animals, and on man. Naturally this involved both analyses and syntheses.

It was accepted, certainly well before 1950, that Los Angeles smog had unusual oxidizing power as measured by the liberation of iodine from KI solution or by using oxidizable substances like phenolphthalin or methylene blue. The presence of ozone in smoggy air was proved by collecting it on silica gel, releasing it, and identifying it spectroscopically. It was separated from interfering substances by passing the air through cold traps at $-180°C$ which catch other oxidants but not ozone.

As the analyses began to clarify the etiology of smog, they reproduced characteristic plant damage by fumigating with dilute mixtures of ozone and gasoline or olefin vapors. Gasoline, ozone, aldehydes or acids alone did not give typical plant damage so it was thought that intermediate peroxidic compounds were needed.

Smog can be produced by irradiating various compounds and NO_2 either by sunlight or by blue fluorescent light. Visible aerosol formation results from irradiating 3 ppm of hexene and 2 ppm of NO_2 in 5 liter flasks, transparent for 3660 Å, and is produced most easily with ring compounds such as cyclohexene. The technic permits comparing the ozone forming capacity of various organic compounds with nitrogen oxide. As the length of the chain paraffins increases from 4 to 9 atoms the ozone forming capacity increases. The olefin, butadiene, is the most active ozone-former found, followed by butene and pentene. Methane, ethane, and the like were inactive.

For a standard or control test *Haagen-Smit* commonly uses 3 ppm of 3-methyl heptane plus 1 ppm of NO_2.

He suggests [3] that the free radicals formed during these photo chemical dissociation processes react with oxygen to form peroxidic radicals which, in turn, may oxidize another molecule of oxygen to ozone. A chain reaction is postulated to account for the formation of high concentrations of ozone.

As rubber is very sensitive to ozone, it was found that bent rubber strips in the test flasks gave a convenient way of determining ozone by the depth of the crack produced in a given time. The irradiations are done in air or oxygen and the light source is either sunlight or blue fluorescent lights [14].

It is stressed that laboratory tests require low concentrations of NO_2—if it goes too high the photochemical dissociation, so necessary for the smog forming and rubber cracking, is much reduced. In practical outdoor conditions the requisite dilution is effected more or less automatically by nature.

The Daily N-Oxide Cycle in Los Angeles

The smog cycle had been defined reliably but until the increasing importance of N-oxides had been appreciated the cycle for these compounds was not

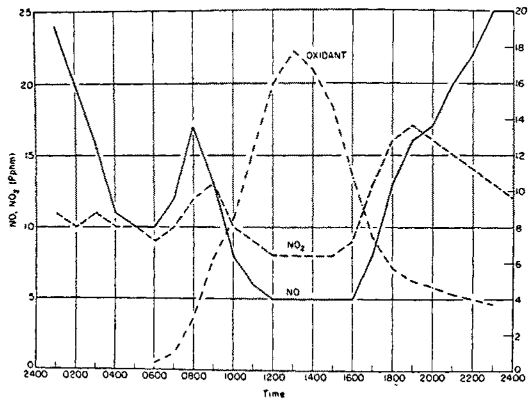

Fig. 5. The daily cycle in oxydant and N–oxides in the Los Angeles area. [15]

established. A recent report by *Faith* et al. [15] shows the curves in Figure 5 indicating that while oxidant (smog former) reaches its daily peak around noon, when solar radiation is maximum, the N-oxides are at their lowest at noon and highest at night. The oxidant needs sunlight for its formation while the N-oxides do not.

The Control of Motor Car Exhausts

In the following table are shown typical analyses of modern automobile exhaust gases in tests by the Los Angeles County Air Pollution Control District [16].

	Idling	Acceleration	Cruising	Deceleration
Hydrocarbons (C_3–C_9), as hexane, ppm	1275	410	354	5125
Acetylenic, as acetylene, ppm	825	18	64	687
Oxides of nitrogen, as NO_2, ppm	8	4180	1606	18
Lower aldehydes, as formaldehyde, ppm	88	1369	264	193
CO %	3.6	0.0	0.4	1.5
CO_2 %	10.0	13.7	12.9	6.1
O_2 %	1.4	1.3	1.1	9.5

It is to be noted that carbon monoxide, CO, goes up during idling while nitrogen oxides are lowest. During acceleration and cruising, combustion is at its best with result that CO is then lowest, CO_2 is highest, and NO_2 is highest. During deceleration, combustion is again poor and CO has risen while CO_2 and NO_2 have fallen. The values for the unburned hydrocarbons are also significant in relation to possible control of exhaust gases.

It is now accepted by the automotive and the petroleum industries that motor car exhausts can produce smog. There is no more competitive industry than the automotive and Los Angeles is the happy hunting ground for automobile salesmen. That the industry can and will improve the performance of its vehicles and control the objectionable exhausts in both trucks and passenger cars is expected, but how soon the needed improvement can be realized is speculative. We must reduce the emission of unburned fuel vapors during deceleration, the worst offender, and we hope for converters to reduce either nitrogen oxides or unburned fuel vapors or both at the same time.

There are converters now on the market which will oxidize unburned fuel vapors, and CO, to harmless water vapor and carbon dioxide but they are poisoned by anti-knock additives, like lead tetraethyl, so they can be applied only to lead-free fuels. It is realized that temperature control in the proposed converters is critical and, up to the present time, this has not been achieved.

If suitable devices should become available today, a modest estimate for their future use by Los Angeles' 2½ million motor cars is three years. The stimulus for making these improvements and the possible financial returns are very attractive and are not beyond man's ingenuity. A reasonable date to expect some such improvement seems to be something like six years or so to develop and about four more to get them accepted, which brings us to 1966.

No one can say that Los Angeles would be rid of its smog if all vehicles now had good catalytic combustion devices of as much as 50 per cent efficiency. Britain suggests an 80 per cent improvement in pollution control would probably be enough in London and, to me, such a figure is entirely reasonable. If we got a reduction of one-half in our motor car exhaust pollution it might prove to be enough.

It is tempting to speculate on the significance of N-oxides from power plant chimneys. No nation has paid attention to N-oxides in chimney gases. The concentrations increase with furnace temperatures—the better the plant is run the more N-oxides we get.

Pollution by Fluorides

The fluoride contaminants are hydrofluoric acid (HF), silicon tetrafluoride (SiF_4), or particulate matter such as the sodium and calcium salts of fluorine. The pure gas (F_2) is much too active chemically to escape as such. Like hydrochloric acid, hydrofluoric can form a mist or fog with water. Silicon tetrafluoride will hydrolyze in moist air and give a white cloud of silica, SiO_2, and HF mist. Likewise the common salts such as NaF and CaF_2 can hydrolyze in moist air.

Forages grown in areas uncontaminated with air-borne fluorine may contain from 2–75 ppm of F while those in air known to be polluted may run as high as 500–1000 ppm depending on meteorological conditions and plant species [17].

Grains like American corn (maize), wheat, oats, and barley are likely to have fluorine levels below 10 ppm with an average of 3–5 ppm. High fluorine in the soil will, of course, raise the fluorine level in plants growing on it but this fact is irrelevant to the present discussion.

So far as I know, there have been no authenticated respiratory poisonings from fluorides of men or animals outside of the metallurgical or chemical plants involved. Nosebleeds, however, are bothersome to workers in either aluminium production or in magnesium founding if concentrations of fluorine exceed approximately 2 ½ mgs/m³. This figure corresponds roughly to 3 ppm calculated as HF, which is far above anything noted outdoors. I do not believe that respiratory damage from HF occurred in Meuse Valley, as suggested by *Roholm* [18], or at Donora or in London. Persons affected in these disasters were not in the robust health of youth but none of the reports, that I have seen, mentioned nosebleeds or the common premonitory symptoms of HF. There is no evidence, so far as I know, that HF can be breathed with dangerous effects unless the person, healthy or unhealthy, is aware of it. Undeniably it is very toxic but so is HCl and some other gases which make themselves known very promptly.

Effects of Pollutants on Vegetation

The order of toxicity of the most important polluting gases to delicate plants is: hydrogen fluorine, chlorine, sulphur dioxide, ammonia, hydrogen sulphide, and hydrogen cyanide. If hydrogen cyanide belongs there at all, it would rank last.

The order of toxicity to humans is quite different. Chlorine is very toxic to humans and was used as a poisonous gas in World War I. Hydrogen sulphide is very apt to cause fatal accidents on the briefest of exposures. Hydrogen cyanide can be lethal rapidly to mammals and insects in concentrations which do not harm plants. For humans, the order of toxicity is probably: chlorine, hydrofluoric acid, hydrogen sulphide, sulphur dioxide, and ammonia.

Great progress has been made in identifying the lesions caused by air pollution to various plants. Some of them are so sensitive and the lesions so characteristic that assessment of plant damage can be used as a guide in determining the extent of the pollution. There have been some splendid reviews of this subject with illustrations both in color and in black and white. [19, 20].

The characteristic lesions from Los Angeles smog are identifiable by skilled plant pathologists. According to *Went* [21] they were of comparatively recent origin—say 1944—and seemed to be associated with the density of motor traffic and especially to increasing use of high octane fuel.

Went has found the same kind of plant damage in other large cities — San Francisco, New York, Philadelphia, London, Manchester, Paris, and Sao Paulo —but did not find it in Houston, Amsterdam or Rome. In Paris and New York it began about 1952, he thought, and he suggests that the introduction of high octane fuel might account for it.

In Figure 6 are *Went's* findings of gasoline consumption from 1947 to 1954. The dotted line, at 12 tons per day, indicates about where plant damage begins to be seen. Note that there are two lines for London since the fuel consumption figures available were for the area of 680 square miles so he assumed that either one half or two thirds would have been used in the central London area of 120 square miles.

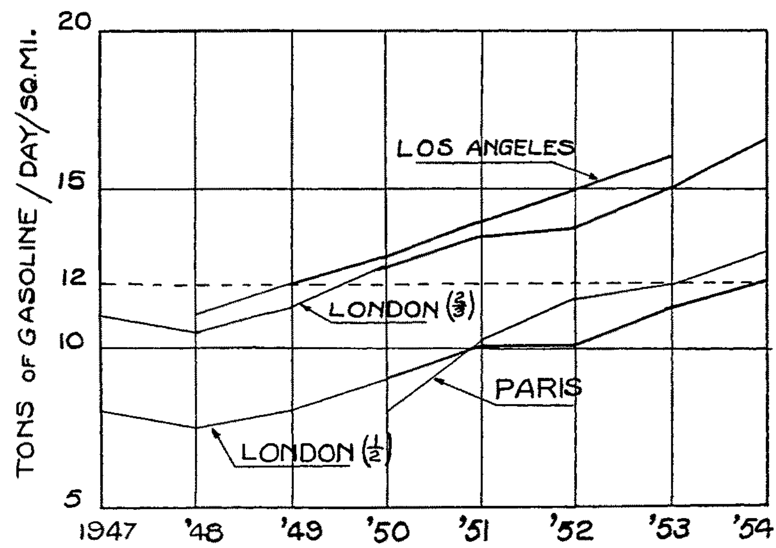

Fig. 6. Gasoline consumption and damage to vegetation. [21]

Conclusion

Switzerland has not the same kind of pollution problem as confronts our large cities in the United States or Great Britain. Your population densities in the industrialized areas certainly compare with ours but your per capita use of fuels for heating or for producing power is much less. Your per capita production and use of hydroelectric power exceeds ours, while your electrification of railroads, and the moderate climate in your large cities assures you of freedom from some of our most vexing pollution.

It seems doubtful that you handle the exhausts from internal combustion engines (motor cars and diesels) any better than we do and you probably will find this particular problem increasing with your increase in use of automobiles and trucks. It is unlikely ever to approach such conditions as we have in Los Angeles, New York, Chicago, or London but it might be wise to heed the lessons which these cities have been forced to learn.

Zusammenfassung

Die Verunreinigung der Luft hängt eng zusammen mit der hohen Bevölkerungsdichte in Großstädten und mit der damit verbundenen Nachfrage nach Energie für privaten und industriellen Verbrauch. Daneben sind «natürliche» Verunreinigungen wichtig für die allgemeine Situation und können sehr ernste Folgen haben bei längerdauernden Wetterstauungen und Temperaturinversionen: Maastal-Katastrophe 1930, Donora USA 1948 und London 1952.

Der «Los Angeles Smog» wurde erst zur eigentlichen Belästigung mit der ungeheuren Zunahme der Bevölkerung in der Stadt und dem damit verbundenen Anstieg der Zahl der Automobile seit 1944. Die Luft besitzt in Los Angeles ungewöhnlich hohe Konzentrationen an Oxydationsstoffen, die zusammen mit den Verbrennungsprodukten aus Motorfahrzeugen und Industrie den «smog» bei warmem und trockenem Wetter in Erscheinung treten lassen. Der Londoner Nebel hingegen bildet sich bei kaltem Wetter. Nitrose Gase werden in Los Angeles als die Hauptursache für die Entstehung des Smog angesehen und es sind bereits Methoden vorhanden, die Konzentration dieser Gase in der Luft herabzusetzen. Fluoride in der Luft stammen immer aus industriellen Prozessen und werden hauptsächlich in der Umgebung von Fabriken getroffen, die Phosphordüngemittel oder Aluminium herstellen. Die Fluorverbindungen schlagen sich auf die Vegetation nieder, die vom Vieh gefressen wird und die Fluorosis erzeugt.

Summary

Air pollution is very closely related to the high population density in big cities, through the discharge of man-made pollutants by combustion into the atmosphere. Natural pollution such as dust storms, fog, haze, volcanic eruption are important in the general problem and can become serious only if combined with prolonged stagnant conditions and temperature inversion: Meuse Valley of Belgium, 1930, Donora USA 1948 and London 1952.

Los Angeles Smog began to become a real problem around 1944 with the tremendous increase in population. The combination of the very unusual oxidative properties of the air in the entire district together with the large amount of products of combustion both from motor vehicles and from industrial processes let the smog occur in dry, warm weather while the toxic London fog occurs in cold weather. The chief offender in Los Angeles seems to be nitrogen oxides, which it would appear possible to control.

Pollution by fluorides emissions from chimneys is wholly industrial and is found in the vicinity of factories which produce magnesium castings or aluminium from aluminium ore. Fluorides deposit upon vegetation which is then eaten by cows and sheep causing fluorosis.

Bibliography

[1] *Putnam P.:* Energy in the Future. Van Nostrand, 1953.

[2] *Ebersole John H.:* Radiation Exposure Patterns Aboard the U.S.S. Nautilus. New England J. of Med. **256**, 67, Jan. 10, 1957.

[3] *Shaw N. and Owens J.S.:* The Smoke Problem in Great Cities. Constable and Co., 1925.

[4] *Douglas C.K.M. and Stewart K.H.:* London Fog of December 5–8, 1952. The Meteorological Magazine, No. 969, vol. 82, Mar. 1953, p. 67.

[5] *Batta G. et al.:* Les problèmes de pollution de l'atmosphère. Masson & Cie, Paris, 1933.

[6] *Firket J.:* Fog along the Meuse Valley. Trans. of the Faraday Society, April 1936, p. 1192.

[7] *Schrenk H.H. et al.:* Air pollution in Donora, Pa. Pub. Health Bull. 306, 1949.

[8] *Roueche B.:* Eleven blue men and other narratives of medical detection. Little, Brown and Co., Boston, 1947.

[9] *Ministry of Health:* Mortality and morbidity during the London fog of December 1952. Report No. 95 (1954).

[10] *Grandjean E.:* Die Verunreinigungen der Stadtluft. Zeitschr. f. Präventivmedizin **2**, 1–19 (1957).

[11] *Haagen-Smit A.J. and Fox M.M.:* Ozone formation in photochemical oxidation of organic substances. Ind. and Eng. Chem. **48**, 1484 (1956). Ibid. (same title and authors and journal) **45**, 2086 (1953).

[12] *Haagen-Smit A.J. et al.:* Investigation on injury to plants from air pollution in the Los Angeles area. Plant Physiol. **27**, 18 (1952).

[13] *Haagen-Smit A.J.:* The effect of light on air pollution. Air Pollution Foundation, Los Angeles, Rept. 15, 1956.

[14] *Bradley, C.E. and Haagen-Smit A.J.:* Application of rubber in the determination of ozone. Rubber Chem. and Technology **24**, 750 (1951).

[15] *Faith W.L. and Hitchcock J.B.:* Third Technical Progress Report, 1957, Air Pollution Foundation, Los Angeles.

[16] *Faith W.L.:* Nitrogen oxides. Chem. Eng. Progress **52**, 342 (1956).

[17] *National Academy of Sciences:* The fluorosis problem in livestock production. Publ. 381, 1955, Washington, D.C.

[18] *Roholm K.:* The fog disaster in the Meuse Valley, 1930: A fluorine intoxication. J. Ind. Hyg. **19**, 126 (1937).

[19] *Thomas M.D. and Hendricks R.H.:* The effects of air pollution on plants. Section 9, Air Pollution Handbook, McGraw-Hill Book Co., N.Y., 1956.

[20] *Middleton J.T. and Paulus A.O.:* The identification and distribution of air pollutants through plant response. AMA Arch. of Ind. Health **14**, 526 (1956).

[21] *Went F.W.:* Global aspects of air pollution as checked by damage to vegetation. Proc. Third National Air Pollution Symposium, Pasadena, 1955.

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Chemikalien in der Nahrung

Von *F. Eichholtz*

In dieser traditionsreichen Stadt möge es mir gestattet sein, den Geist eines ihrer großen Söhne zu beschwören: *Jacob Burckhardt* leitet seine «Kultur der Renaissance in Italien» mit der Bemerkung ein, es sei ihm genügend bewußt, daß er mit sehr mäßigen Mitteln und Kräften sich einer überaus großen Aufgabe unterzogen habe. – «Die geistigen Umrisse geben vielleicht für jedes Auge ein verschiedenes Bild – und subjektives Urteilen und Empfinden wird sich jeden Augenblick beim Darsteller und beim Leser einmischen». – Dieses aber ist die Grundsituation von uns allen, und sie wird besonders verworren, wenn wir uns mit chemischen Substanzen in der Nahrung beschäftigen.

Die jetzige Situation

Ein Mangel an Authentischem spielt hier eine beklagenswerte Rolle, und zwar vornehmlich durch die Schuld einer Gesetzgebung, die leider noch in