

Following the Smoke Trails

Weather Bureau Expert Says Smelter Smoke Costs Salt Lake More Than \$2,000,000 a Year.

By J. CEOL ALTEB, IN MINES AND METHODS FOR FEBRUARY.

Twelve autumns ago after passing for the first time through the broad, bright streets of Salt Lake, mounting to the crown of Ensign peak to get a better conception of the most wonderful picture of the plains, my memories of the stock yards district, Chicago, faded far away as I saw spread out before me the foliage-trimmed, sky-kissed, "New Jerusalem"; a city that lay foursquare in the September sun—yet like the holy city of revelation, it seemed to have "no need of the sun, neither of the moon to shine in it, for the glory of God (nature) did lighten it." I had come west seeking the light of a new day—a clear day, and before the neighboring sun closed its eyes beyond the lake at the end of my first day here I was convinced that indeed, as declared the Mormon prophet, "This is the Place!"

But another day was soon to dawn, dimly, and as the gray, poison smoke, central springing up in birth from the center of the valley, began to curl and entangle its endless self over the valley with increasing density day after day, the dawning of the new days became more and more a "deed of darkness"; a dismal transition from the night to the day.

And so again, recently, as I wandered up the slope, out of the latter-day smoke to the resting place of old on Ensign peak, north of the city, in quest of the lost "city of high ideals," and looked out upon a billowy sea of smoke and fog, I realized that the loved one had passed away, into the great beyond—beyond the fog somewhere, discernible only by its faint noles coming up through the gloom. It was then my nostrils were cleared of their sulphurous, sooty breath for a spell and mentally I saw the tragic picture of a buried Pompeii, overcome by a brick built volcano, spewing sulphurous lava fumes; and after witnessing the glory of a golden sunrise over the Wasatch—a picture no longer the property of Salt Lake City—I trudged grimly back into the fog, recalling with great vividness, the similar fate of Biblical Sodom, whose reckless desires for materials and sensual advantage had, like the business-getting desires of Salt Lake City, resulted in a rain of brimstone, and a day without a sun.

The terrible truth of this single experience is set forth in the record of foggy, smoky days maintained for forty years in Salt Lake City by the United States Weather Bureau; and a casual inspection of this record in the accompanying table, reveals a tale that is stranger than any fiction, and one which cannot be told too often for the good of the town:

Foggy and smoky days in Salt Lake for twenty-two years. (On about half of these days the view was obscured entirely beyond 1000 feet; on the remainder, the view was obscured beyond one-half mile; no record of the lesser amounts of smoke or fog.) (From U. S. Weather Bureau Records.)

Date.	Year.	Date.	Year.
1891	None	1902	8
1892	8	1903	29
1893	2	1904	6
1894	None	1905	22
1895	1	1906	10
1896	3	1907	25
1897	None	1908	19
1898	1	1909	19
1899	2	1910	19
1900	6	1911	9
1901	2	1912	25

In connection with this table of foggy or smoky days it must be stated that the Weather Bureau officials record only the fog or smoke that is a distinct phenomenon, and makes no special mention of those scores of days throughout the year when all the mountains and most of the valleys are obscured by the dull gray, view-densifying haze, confining its entries only to those days when objects beyond a half mile are obscured.

Practically all the fogs recorded from 1891 to 1901, inclusive, were of the moist kind, which occurred largely at night, because of the high barometric pressure, and the general coolness of the layers of air, due to radiation and to the flow of cold air into the valley from the canyons. This sort of fog is usually of the cleaner, though moist kind. Such fogs were quite common in the last eleven years as in the previous eleven years, and the typical morning and day fogs and smokes have been noted. The first-named variety of fogs will occur in other valleys and over other cities of Utah quite as readily as over Salt Lake City, and general records by government observers show these to have occurred simultaneously in Salt Lake City, Provo and Ogden, and other places, but the latter kind, the dirty, grimy sulphurous smoke-fogs, are the sole property of Salt Lake City.

week or two when patches of snow were observed to maintain high humidity conditions.

In January, 1913, more foggy and smoky days occurred than in any other month during the past forty years, there being eighteen gloomy days. During these January fogs the wind averaged from one to six miles per hour from southerly directions. It also is of interest to note that from the 9th to the 18th, inclusive, when only one light fog occurred, the total daily number of miles of wind blowing across Salt Lake City averaged 293; but during the continuous foggy, smoky weather from the 19th to the 31st inclusive, the average daily number of miles of wind was only 105, or only about one-third as much.

The total amount of moisture contained in the atmosphere during our winter mornings, with relative humidities of about 70 per cent and average temperatures around 30 degrees, is about 1.3 grains per cubic foot, by actual weight. Not all of this can be condensed on smoke and smelter dust particles, or absorbed by the hygroscopic sulphuric acid, in only one-fourth of it appears as visible moisture (which is doubtless a conservative estimate for many mornings), at least that amount, 0.3 grains of new sulphuric acid is produced for every cubic foot of air from the ground up to the average limit of the smoke and soot. This, it must be remembered, is the amount added to that already contained in the air, thus making the total amount very great. If it is not recognized, it is very easy to see that, if driven out of the valley by windstorms.

Effect of Moisture in Air.

If the hundreds of tons of sulphurous soot suspended in the air over Salt Lake City at any one time were perfectly dry it would cause but a relatively small percentage of the detriment that actually occurs. Absolutely dry smoke particles of whatever size they may happen to be, would be very much more buoyant than moisture-coated particles, and would not only float higher and be more thinly distributed throughout the atmosphere and have less tendency to fall in condensed clouds upon the city, by reason of their floating higher, would find themselves in air whose movement is normally from five to twenty times as rapid as the movement of surface air. And thus the dry dust-like soot be carried beyond the city limits before it fell to earth. Moreover, in a perfectly dry air, where no moisture could appear on the smoke particles by condensation, the lower strata of air would contain practically nothing but the coarse, heavy particles; the finer and more troublesome soot and dust occupying the greater altitudes, finding as nearly stable equilibrium high in the air as the heavier particles find in the lower, denser air.

And so far as the smoke particles remain in this nature, distribution of the coarser and finer particles occurs, but unfortunately, with winter humidities in Salt Lake City of from 65 per cent to 85 per cent of saturation, probably no smoke particle, however small, descends very far toward the earth on its return journey before it is cooled to the temperature of the dew point, and annexes its full carrying capacity of moisture.

Instantly then do we have the light-obscuring smoke particle of say, one three-thousandth of an inch in diameter increase in size to one thousandth of an inch in diameter, that is, rendering an atmosphere clogged with dry smoke and dust particles from the smelter smoke and elsewhere, about three times as opaque with the moisture or fog particles added. Of course, in nature, this condition is usually limited to small streams of cold air, or to small regions of quiet air, the smoke being gradually dissolved in nature it is also true that one dust-moisture particle will unite with others, the tendency to coalesce being limited only by the amount of humidity available.

The condensations on the larger particles may not immediately increase their size three-fold in low humidities, as it does the smaller ones, yet the increase will soon reach this dimension if there is sufficient humidity available. Therefore, in considering the actual sight-carrying quality of the air over the city alone, with an air so dry that no cooling dust particle could reach the dew point and collect its moisture load, if we could see on object three blocks away, it is reasonable, in general, to calculate that in a moist air, with all particles collecting moisture, the same object would be obscured beyond one block or just one-third as far.

Part Played by Mineral Oils.

Moreover, we have it from eminent meteorologists and engineers, that the unaccounted mineral oils in the fuel smoke forms an oil film around every fog or moisture particle which greatly increases its proportion, renders the fog more tenacious and much more durable than a plain, common country or seashore fog. The moist obscuration, now of triple density, is therefore becoming a far greater person than the former mere mass of segregated, separated, unbonded smoke particles.

The sulphur oxide gas, rendered so abundant in our air by the smelters, coming in contact with moisture particles, instantly forms sulphuric acid, as we have previously pointed out. In low humidities, when there is a dearth of moisture, the new sulphuric acid is concentrated form; but during high humidities, with abundant moisture, the more dilute sulphuric acid naturally results, at first.

However, unless the relative humidity is very close to 100 per cent, or actual saturation, it is improbable that the sulphuric acid poison is very much diluted. This is because of the great and unchangeable thirst of the sulphuric acid and the sulphur dioxide gas for water; and where the moisture is in sufficient quantity to render the atmospheric sulphuric acid somewhat dilute, the chemical tendency of the sulphur dioxide is to attach more of its own molecules to the water, or sulphuric acid particle if more are available, thus maintaining a very condensed or strong grade of acid in the air. Our smelter-fed air seldom goes hungry for sulphur dioxide.

These deductions are made from the statements found in some of the newer and more thorough text books on chemistry, making a sulphuric acid molecule by one volume of water at 15 degrees. Therefore the significant fact is apparent that if one volume of water can annex as much as fifty volumes of SO₂ gas, making a sulphuric acid molecule for every molecule of water (obtaining

the other oxygen molecule from the air) the air containing the water and dust and smoke particles as obstructions will be rendered at least two times as opaque, making objects visible at only one-half the distance and obstructing one-half the former amount of sunshine, by the mere manufacture of the sulphuric acid; and thus the view is shortened to about one-sixth its original length in clear air.

But we breathe down into our lungs and the poison passing the nose must finally reach the lungs, and of course gets in its work on every surface. Many folks complain of irritating coughs in foggy weather, and usually attribute it to the "dust" in the air, though these same persons do not cough when carrying coal or cutting kindling, or automating dusty roads. The real trouble would seem to be in the irritating sulphuric acid.

Why Smoke Ruins Clothes.

The moist, fog-filled dirt clings like paint to everything, from our draperies to our memories. The expert who reports that the dirt, removed from a portion of the air in the laundry, the most dirt is that tenacious; clothing, furnishings, tapestries and so forth wear out much quicker against a washing machine than against our backs and in use, they get it about four times as often as they would without the moist smoke.

But the mere moisture alone is not the greatest problem by any means, for laundries and industrial housewives, in care, can safely chase away a great deal of dirt, but the sulphuric acid depositions of the sulphuric acid that are irreparable and unpreventable. A little atom of dust gathered a little molecule of water as a cloak, and this molecule attracted a molecule of sulphur dioxide, and this sulphur dioxide attracted chemically an additional molecule of oxygen and pure poisonous, penetrating sulphuric acid was formed, and this sulphuric acid, carried about by the original dust carrier, or in many cases being very fine (perhaps inconspicuous) to be transferred to every surface, moisture from the receiving surface, alights on every surface, seeking whom and what it may devour.

H. M. Wilson, an engineer in the United States bureau of mines, writing recently in the Iron Age Magazine, says that in addition to the mortality increases where the sulphurous content of the smoke is great, and in addition to the losses from dry goods of all kinds, the library books and office records, from the mere soot and dirt, the amount of painting and renovation rendered necessary by the caustic action of the sulphuric acid in the smoke upon all paint, iron and brass work," is considerable, and Mr. Wilson was writing of the fact that he has to contend with the sulphuric acid from the smelter smoke, whereas we, in Salt Lake City, have from five to twenty times as much sulphurous matter in our air, as a rule, to blight and poison and devour.

If the air were so dry that the smoke particles could cool and not overreach the dew point, practically none of the disastrous results would occur; yet with humidities of about 70 per cent and dew point temperatures of from 20 to 25 degrees, the moisture in the air would be a more or less extent, and forthwith, the heavy charge of sulphur dioxide gas, always in the air, begins the coal-gas, and the manufacture of sulphuric acid, the deadly poison, upon the dust particles. And the spot where it is pointed out, some physicians have claimed that the sulphur dioxide will combine with the invisible vapor, not yet condensed, just as our garments will take up moisture from the invisible vapor on a moist day, thus forming the sulphuric acid independent of the fog unit.

Sulphuric Acid's Insidious Ways.

But omitting this last theory, plausible as it is, we find the sulphur to be responsible for a very large percentage of the obscuration, and for a still greater percentage of the final destruction of property.

A great deal more washing of fabrics is needed, as well as more cleansing of all cleanable articles; and as the tiny bits of cotton or wool fiber from the fabric break off, and the garments, or bedding, or carpets, or tapestry, or drapery or tapestries begins to wear out, we realize that the life of the article is mysteriously shortened by what appears to be the laundering or the unusually vigorous methods necessary for cleaning; or by fading or actual decay; yet the terrible fact is ever before us; the goods is being partially eaten by the ever-present sulphuric acid!

The laundry rubbing even in the dry cleaning presses on the more precious garments and fabrics does produce some threads off at the same place, resulting ultimately in a hole; nor does it cause a garment or a fabric to pull apart, or go in holes under very slight stress, after having been laid away apparently clean from the dusts here—but in reality spotted with sulphuric acid deposits.

Much evidence has been introduced in courts and elsewhere showing that has not only been corroded and removed by sulphuric acid deposits from the atmosphere, but that the wires have been so seriously acid eaten that they have fallen apart. And if these things be true, we cannot blame the salesman, shopkeeper, or the laundry for the short life of a shirtwaist, the hat, the waved and becombed hair of a clothesline to every passing particle of sulphuric acid on a smoky, foggy day; or for the short life of an expensive window curtain for great quantities of sulphurous soot, in the air we are trying to introduce into our library or bedroom for ventilation purposes.

When threads of the curtain "break" before it has been cleaned, it is not because it has rotted down in the dirt, by any means, a dirt has teeth (sulphuric acid) and they cut as keenly as a two-edged sword; it is more insidious than moths, and more certain to get in its destructive work wherever it alights, though in many cases the dirt alone ruins the article before the final action of the sulphuric acid.

Since sulphuric acid is quite heavy, compared to air, like most fluids in finely divided state, the larger particles of it float naturally nearer earth, as do the larger dust particles; and

since in fog strata there is almost no vertical component of air motion, these heavier particles of sulphuric acid flowing leisurely along horizontally with the fog, partially disguised usually, as a smoke particle with a "jag" on, are the specks of poison that come most frequently in contact with our property.

Smoke's Effect on Health.

While disease and discomfort in the human body are about as elusive as anything imaginable that we have to deal with, physicians as a rule are frank to admit that there is some powerful poison in city smokes or fogs, some stating without reserve that the poison is the sulphuric acid, if its identity may be traced by its results.

It is said to cause an intense smarting of the eyes in some people upon emerging suddenly into a well-laden stratum of sulphuric acid-carrying air; persons troubled with nasal catarrh complain that during "clammy," foggy weather, their mucous membranes often become intensely irritated and while this is often said to be the result of the sudden change in humidity, there appears good reason to believe that if the sulphuric acid particles in the air will eat galvanized wire fencing in two, the small amount of sulphuric acid in contact with the nose membrane might also make itself known there.

But we breathe down into our lungs and the poison passing the nose must finally reach the lungs, and of course gets in its work on every surface. Many folks complain of irritating coughs in foggy weather, and usually attribute it to the "dust" in the air, though these same persons do not cough when carrying coal or cutting kindling, or automating dusty roads. The real trouble would seem to be in the irritating sulphuric acid.

Again to quote Mr. H. M. Wilson from the Iron Age Magazine: "One of the principal ingredients of smoke as sulphuric acid, and every dweller in a smoke-laden community must each moment take into his lungs this powerful poison. He quotes eminent physicians of Europe and America as saying, 'The death rate from all lung diseases is largely increased and tuberculosis gets in its deadly work in half its usual time. Now if these terrible things are true in average cities (he was speaking of all large cities) how much more potent must be the sulphuric acid in such quantities as exist in Salt Lake City?"

Must this become a city from which fresh air excursions will be made out into the unaccounted mountain air to rest, refresh and rejuvenate child lungs and eyes, and a city to be avoided by every person of whatever age who appears to be troubled by the smoke of other cities?"

This same government official, Mr. Wilson, also quotes the city park commissioner of St. Louis as saying that his shade trees, both the evergreens and the hardwoods, were being suffocated at the rate of 5 per cent a year, saying that all the older trees would be gone within twenty years because of the death of sunshine and the caustic action of the sulphuric acid.

And it is a well-known fact that outdoor flowers in Salt Lake City are not only often imperfect, but dwarfed because of the poisonous ingredients from the air; and the leaves of all trees are more or less scorched by the sulphuric acid, especially in late summer, after several weeks of quiet fair weather, when the sulphuric acid is permitted to accumulate on the moist leaf and plant surface; thus it is manufactured upon the leaves its subsequent destruction takes place.

Costs Salt Lake \$2,000,000 a Year.

Of the many ways in which finan-

cial loss results from smoke, none would be so great without the sulphur. The obstruction of the sun's rays causing the use of more artificial light, less efficiency of employees, and so forth, would be less because the sulphuric acid is an obstruction just as is any other particle. The great loss in library books, office records, and the like, would be far less if the grime did not contain the staining, discoloring and devouring sulphuric acid.

Mr. Wilson, quoting official figures, shows the annual loss from smoke and resultant influences in Cleveland, Ohio, to be \$12 per capita, and in Cincinnati and Pittsburgh to be \$20 per capita. The values for all large cities show an average of \$17 loss for every man, woman and child residing in cities. It will not be forgotten, however, that this is a calamity which very rarely befalls the small city or the country town.

Now it is manifestly too conservative to place Salt Lake City in the list as an average for smokiness in these latter days, and probably a per capita loss each year from smoke and sulphuric acid here would reach \$25 or even \$30 considering all results. However, to be as conservative as possible in our reckoning, let us assume the Salt Lake City loss to be no more than the amount shown in the "average" cities of the United States, or \$17 per annum per capita.

At the close of January, 1913, an estimate of our population made by the Salt Lake Tribune from records of the public service corporations and others, was about 115,000 people. At \$17 each the total annual loss is practically \$2,000,000.

With this fact in mind, not forgetting that we have placed it as low as possible, let us return to the table of smoky, foggy days. Twenty-five gloomy days occurred in the first eleven years and 221 in the second eleven years. With an increase in the number of foggy days proportionate to the population and coal consumption increase of 70 per cent, we would, normally, have had forty-two instead of 221 foggy days in the second eleven years, as previously pointed out. The excess of 179 foggy days, or sixteen and one-fourth per year, has plainly been the result of the smelter and sulphuric products.

Now it is well known that there is no smoke damage on bright clear days; that when smoke rises high and is blown rapidly and does not accumulate in quietude in any portion of the city, even when it is not consumed properly. That there is no measurable loss from smoke which is not forced ground, ward and held in masses by moisture, winds and other influences, against ourselves and our property, and with such denseness as to diminish the sunshine.

Therefore, we arrive at the significant and indisputable fact that our loss of \$2,000,000 annually is very largely confined to the foggy, smoky days, and so far as properly placing the responsibility is concerned, we can assume with perfect fairness that the loss be divided into units presented by the foggy days, exclusively, as observed and recorded by the U. S. weather bureau.

"Smoke" Costs Us \$1,625,000 Yearly.

The twenty dirty days per year (since 1902) entailing the loss of \$2,000,000, is \$100,000 for each and every day on which a fog or a smoke were recorded in the government records. And we have seen that the smelters are solely responsible for sixteen and one-fourth of these days in each of the past eleven years, which gives a loss from the sulphurous spouting smelters

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alone of \$1,625,000 each and every year, probably varying with the number of foggy days and one-half this value to twice this value.

The smelter fumes continue their depredations throughout the farming communities of the valley, being caused especially from the Murray plant, partially, it is said, by the "muzzled" Middlevale plant. And while the damage is probably less to crops and livestock than formerly when arsenic-producing ores were handled more abundantly, and while prompt settlement is usually made with the individual for any damage to crops and domestic animals, the loss to the public for the valley shade trees; the trouble said to be caused by the sulphuric acid deposited on fruit which is sold in the local markets and is reported by some as being the probable cause of certain stone-ropes formerly when arsenic-producing ores were handled more abundantly, and while prompt settlement is usually made with the individual for any damage to crops and domestic animals, the loss to the public for the valley shade trees; the trouble said to be caused by the sulphuric acid deposited on fruit which is sold in the local markets and is reported by some as being the probable cause of certain stone-

Ducks Poisoned Worth \$288,000.

Fred W. Chambers, state fish and game commissioner, estimates that 5,000,000 wild ducks died in the marshes around Great Salt Lake during the past three years. A dozen or so of these fowls were taken to the pathological laboratory of the United States bureau of animal industry, and under the direction of Dr. J. S. Buckley and Dr. J. H. Mohler, were carefully examined. Efforts were made to infect live animals, birds, and ducks with cultures from the dead ducks, but the "disease" could not be reproduced artificially, and thus it was proven not to be transmissible. The irritation of the intestines, or the catarrh condition, was then reported by Dr. Buckley (in a letter to Mr. Chambers, and another to Dr. M. E. Stewart of this city) to be "due to inflammation of the alimentary tract caused by sulphuric acid."

As pointed out by Dr. Stewart and Mr. Chambers, a great deal of sulphuric acid accumulated on the ground during the dry weather of summer, and much larger quantities of the heavier-than-air sulphur dioxide gas in the valley air, so that the first good rain of autumn produces vast quantities of sulphuric acid, which attaches itself to every object and wisp of vegetation throughout the valley, and forms a

coating over all quiet water surfaces. And thus the ducks are poisoned millions.

Mr. Chambers explains that the folks would be glad to pay from 40 cents apiece for good ducks to and they should therefore be worth from 10 to 20 cents each in the marsh; but at his most conservative value estimate of twelve one-half cents as food to the state, find the deadly fall of the ducks from our game bird losses alone three years of \$625,000 or \$208,000 year.

This sum combined with the damage in Salt Lake City, alone, regarding the unpaid-for damages where in the valley makes an average charge against the sulphurous gas sold from the smelters of \$1,833,000. And with this annual load upon a "Pompeii" be unearthed; as a "Sodom" breathe again the air of the mountains!

Pneumonia Follows a Cold.

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