

Space and Air Pollution

Ann. Vars Paper

Spatial Aspects of Air Polln. Notes by Marion Seffrey, 1969

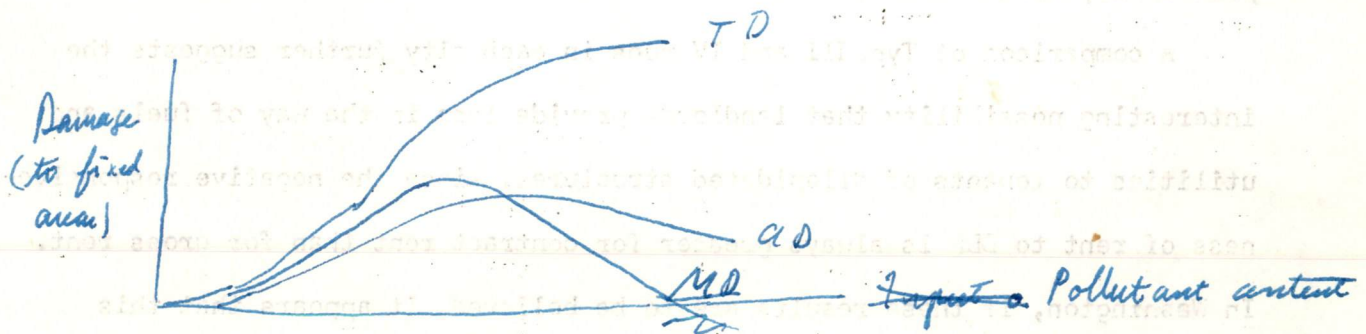
This has not been adequately treated by those presently working in air polln.

Topic that needs more research.

Spatial aspect is part of iv, & vi, Ambient air quality as f. of emissions; & damage as f. of ambient air. We have to relate emissions to the area affected

1. Prodn. fn. — dim. returns.

Prodn. of a bad -- air polln. But some usual variable propus. applies. "Damage fn."



(Upper limit on TD, land is abandoned.)

ALL

Because this variable was roughly invariant in the sample due to census methods, results are uniformly nonsignificant (regressions incorporating this variable are not reported in Table I).

DLP

The results for the DLP variable, save those for Washington, D.C., are generally consistent with prior expectations. In Type II runs, the coefficients of DLP are nonsignificant or are of smaller negative magnitude and significance in all three cities than they are in Type I runs. This may suggest that DLP is principally a neighborhood characteristic, the effect of which increases with increasing BLP, since DLP is quite low throughout the Washington area, and is considerably reduced when the sample is restricted to principally single family residential tracts.

A comparison of Type III and IV runs in each city further suggests the interesting possibility that landlords provide less in the way of fuels and utilities to tenants of dilapidated structures, since the negative responsiveness of rent to DLP is always greater for contract rent than for gross rent. In Washington, if these results are to be believed, it appears that this differential is enough to cause gross rents and DLP to be positively related.

If DLP is considered as a neighborhood characteristic, the negative coefficients and their tendency to become smaller with DLP (larger negatively) generally support the view that the costs of a coalition to do something about the neighborhood problem "dilapidation" increase exponentially with DLP, a measure of the number of parties which must be involved given rough constancy of the number of units per tract. This interpretation is consistent with the theoretical work of Buchanan and Tullock [1] and Mishan [15].

~~2. As possible in future~~

2. Objective of control — minimize efficiency of pollutants in causing damage. Avoid middle zone, Stage II.

Left side of graph — low density — is obviously good. Dilution is solution.

Right side might look good, too — concentrate polluters in "smoking lounges". Zone them together.

Each pays the price of exposure to others, as price of polluting. Is this good?

Analogy w. water — stream specialization. All you need is a redistrib. mechanism.

other arguments of the demand function. Property characteristics have been used only for purposes of classification.²⁴ Since both property and household attributes properly appear in a housing demand function, the similarities between the income elasticities here reported and those reported elsewhere seem worth noting.

The income elasticity results for owner occupied properties reported in Table I are closer to the 0.6 estimate obtained by Maisel and Winnick [12] than to the 1.5-2.0 estimate obtained by Reid [25] and are roughly the same as those obtained by Lee [11]. Our results thus seem to be consistent with those obtained by other investigators. Moreover, this consistency would appear to corroborate our contention that income elasticity can and should be inferred from a cross-section model like that employed by RH and more fully developed here.²⁵ These results are also consistent with previous work which indicates that income elasticities are somewhat higher for owner occupied properties than for rental properties.²⁶

²⁴The work of Ridker and Henning is the sole exception.

²⁵Since the coefficient they obtained for their income variable implies the ridiculously low permanent income elasticity of about .05, RH apparently thought their income measure was indeed capturing the effects of omitted property attributes. A careful check of their data, however, revealed that the median family income of a single census tract had mistakenly been entered as zero. The correction of this mistake changed the implied elasticity for St. Louis to that presented in Table I.

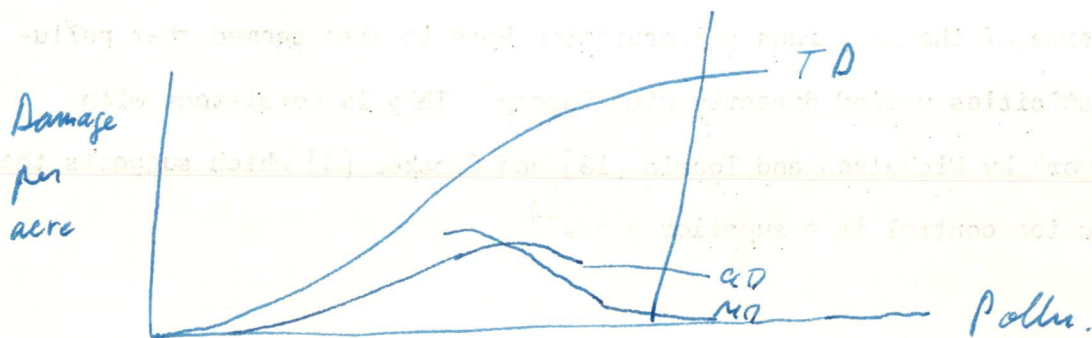
²⁶Because observations are at the tract level, there are unavoidably many tracts in the rental runs with a substantial number of owner occupied properties, and some tracts in even the Type II runs with some rental properties. The income measure, MFI, is a median for all families in each tract irrespective of tenure, so in none of the run types is it precisely the appropriate income measure. Furthermore, given that the income of renters is lower than that for owners, there is some tendency for income elasticities for owner occupied properties to be understated and income elasticities for rental properties to be overstated.

3. Not workable w. air, usually, bec. polln. not contained.

Fig. 1 doesn't show total damages, ^{from air emission,} but only for a fixed area.

Trouble w. air polln. keeps spreading out. Area not limited by focusing emissions, [unless they largely escape upwards above the biosphere or anthroposphere; or fall to ground; or are contained in a valley.]

Can modify Fig. 1 to show total damage from an emission.



ΣTD is Damage per acre $\times$ No. of acres.

This is crudely repd. by area under curves — altho. actually, left side shd. be expanded bec. area grows w. distance from ground zero. This can be approx. by using log scale on abscissa. (In linear distance from ground zero, area Δ w. square and polln. declines w. square. i.e., double area & halve concentration, so

is set,²¹ standards are being set at roughly the lowest levels which (on the basis of our results) could be consistent with the sufficient conditions for a cost-benefit optimum.²²

The minima of the plots for the sulfation variable fall between .7 and .8mgSO₃/100cm²/day. However, most ambient air quality standards for sulfur oxides are stated in terms of a maximum allowable number of parts per million of sulfur oxide (by volume) per unit of time. Since there is no commonly accepted factor for converting the sulfation measure into parts per million of sulfur dioxide, the extent to which ambient air standards correspond to levels at which marginal benefits seem to be minimal cannot be determined.

A number of alternative formulations which would permit elasticities with respect to pollution to vary as quadratics were tried to allow for this phenomenon. The results were not particularly impressive and are not reported here.

In some of the many runs not presented here it also seemed that pollution elasticities varied directly with income. This is consistent with earlier work by Michelson and Tourin [13] and Crocker [4] which suggests that air pollution control is a superior good.²³

MFI

All previous cross-section studies of the permanent or current income elasticity of demand for housing employed household characteristics as the

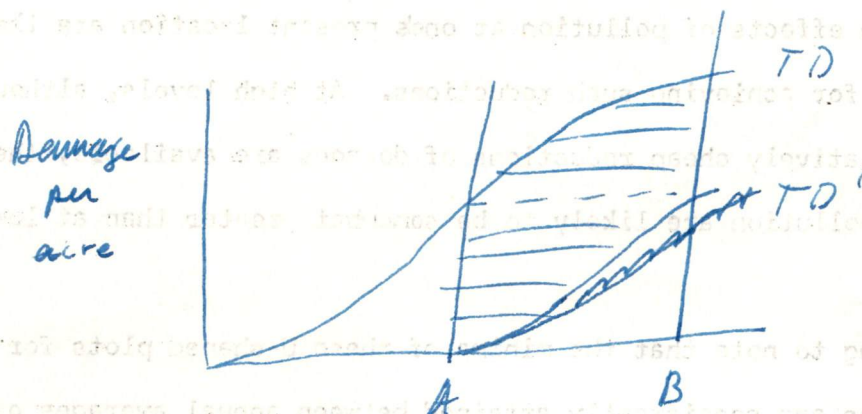
²¹Evidence supporting this hypothesis is available in [2].

²²To be consistent with the sufficient conditions for a cost-benefit optimum, marginal benefits of air pollution control must be non-decreasing in the neighborhood of the air quality standard.

²³This, and some other anomalies which occur when the sample is partitioned in various ways, give cause to believe that the equations presented in Table I are not specified correctly.

damage in 2d ring is greater if AD is higher at lower conc. (i.e. v.v.)

Now, can damage be reduced by conc's emissions?
Gain from togetherness, to reduce area affected?



So, conc. of sources is bad. They reinforce each other while together; and don't reduce area affected.

Model needs much improving, re areas involved.

But some conclusions are suggested, re locational aspects.

a. Segregate emitters from each other, at per.

[But smoke zone is ok if to lee of pop. i.e. a stronger principle overrides a weaker, viz. segregate emitters from people.]

Thus downtown shd. have very strict controls. Crack down there first. 2 reasons: conc. bad; & are more receptors there.

In almost all instances, a U-shape is produced. That is, it would appear that price and rental responsiveness to pollution is quite marked at relatively extreme levels of pollution, and relatively moderate at moderate levels. This is generally plausible behavior. At low levels of pollution, the marginal cost of reducing dosages by a small increment is likely to be quite high, since a movement well out into the country side or very great expenditures to overcome the effects of pollution at one's present location are the only available means for achieving such reductions. At high levels, although opportunities for relatively cheap reductions of dosages are available, the marginal effects of pollution are likely to be somewhat greater than at low levels.

It is interesting to note that the minima of these U-shaped plots for suspended particulates are consistently attained between annual averages of 65 to 80mg/m³/day. These two levels of pollution bound pollution levels which are often selected as ambient air quality standards for suspended particulates.²⁰ Furthermore, the upper bound of this range, 80mg/m³/day, is the threshold at which, according to the National Air Pollution Control Administration, "it is reasonable and prudent to conclude that adverse health effects in particular segments of the population may be produced"[22, p. 12-20]. Thus, by accident or by design, air pollution control officials appear to be setting ambient air quality standards for suspended particulates at or near a level where the marginal benefits of control cease falling and begin to rise. Under the plausible assumption that marginal costs of attaining ambient air standards vary inversely with the level at which the standard

²⁰See for example, standards cited in [20, pp. 142-144].

~~Note~~ Note this doesn't ~~not~~ indicate differing pop., needs. It is easier to impose strict controls in small area. It argues for segregating dirty plants. Argues for separating autos, i.e. keep them out of downtown. Avoid using them for mass transit. Since segrega. is very costly, implies there are limits to what can be done by locational controls.

Exceptions; where conc. is ok.

- gas escapes upwards. i.e. no or few temp. inversion.
- area bounded by hills, - but then buildings is few
- area " " desert
- negative synergism, i.e. pollutants neutralize each other. Empty box.
- first emitter drove out all receptors. This kind of area specialization is good.

b. Segregate emitters from people

Conc. people in areas to be kept clean. all costs of enhancing environment are area-sensitive. Limit area whose environment must be high class. Focus control measures there.

Low density pop. prevents this. People are everywhere.

Focus people in center. Protect center by dispersing polluters.

✓ Disperse polluters; concentrate receptors.

c. Segregating sources won't help if everything comes back

together anyway. L.A. Circle of dispersion always overlaps some. Don't A air supply as fast as A land supply, but move into area already affected and add to auto use.

d. Impose $P = MC$. MC is Σ of damages over whole area.

$MC > AC$, almost always. Even if part of yr. area is in

Stage II, most in Stage I. Justifies strict controls

If all in Stage II, conundrum.

Table I
SUMMARY OF RESULTS
Washington D.C.

DEPENDENT INDEPENDENT INDEPENDENT	Type I	Type II	Type III	Type IV
Const.	3.3901 (.4012)	1.1617 (.5622 [*])	.2428 (.4441 ^{**})	.4705 (.3859 ^{**})
ln (PSN)	-.0712 (.0222)	.0010 (.0270 ^{**})	-.0905 (.0239)	-.0727 (.0207)
ln (PPT)	-.0610 (.0318 ^{**})	-.1698 (.0509)	.0049 (.0316 ^{**})	-.0302 (.0275 ^{**})
ln (MFI)	.7677 (.0447)	.9970 (.0587)	.5109 (.0492)	.4650 (.0431)
ln (DLP)	.0044 (.0059 ^{**})	.0113 (.0079 ^{**})	.0121 (.0055 [*])	-.0054 (.0048 ^{**})
ln (OLD)	-.0106 (.0103)	-.0213 (.0107 [*])	-.0606 (.0125)	-.0408 (.0108)
ln (NWT)	.0251 (.0064)	.0321 (.0080)	-.0043 (.0066 ^{**})	-.0124 (.0058 [*])
ln (DIS)	-.0582 (.0158)	-.0312 (.0097)	-.0216 (.0152)	-.0111 (.0132 ^{**})
ln (MRM)		.9064 (.1948)		
R ²	.6966	.7897	.6963	.7549
S ²	.0222	.0179	.0181	.0136
T	275	121	218	218

*Not significantly different from zero at the .01 level.

**Not significantly different from zero at the .05 level.

b. (revised)

Problems of dispersed reception

— Pollutants linger longer. Angle of dispersion widens.

That includes vertical dispersion, i.e. more stack fallout reaches anthroposphere.

e. Polln. is a disc. of urban scale. As with no. of emitters. So, argues for limiting size of conurbations. (i.e. is one factor pushing that way -- may be offset by others.)

But doesn't argue for lower density of receptors. Pollutants spend longer time in popd. area. Bigger conurbations exhaust slower.

f. Low density generates its own polln. among other costs

Autos

~~Higher~~ Higher rates for electric & gas, due to hi distrib. cost, discourages conversion to cleaner fuels

Higher xpt. cost to landfill sites, shift to incineration.

DEPENDENT INDEPENDENT	Table I SUMMARY OF RESULTS Kansas City (excluding Independence, Mo.)			
	Type I	Type II	Type III	Type IV
Const.	3.5775 (.7261)	-1.2325 (.7568)**	-.2997 (.4875)**	-.4182 (.6677)**
ln (PSN)	-.0782 (.0396)	-.0649 (.0312)	-.0813 (.0251)	-.0895 (.0343)*
ln (PPT)	-.0876 (.0362)*	-.0641 (.0290)*	-.1237 (.0254)	-.0972 (.0347)
ln(MFI)	.6720 (.0898)	.8130 (.1080)	.5566 (.0604)	.5480 (.0827)
ln (DLP)	-.0405 (.0094)	-.0028 (.0088)	-.0212 (.0059)	-.0329 (.0081)
ln (OLD)	-.0721 (.0124)	-.0464 (.0104)	-.0750 (.0136)	-.0517 (.0187)
ln (NWT)	-.0058 (.0067)**	-.0133 (.0056)*	.0081 (.0041)**	-.0020 (.0057)**
ln (DIS)	-.0623 (.0245)*	.0349 (.0228)**	.0063 (.0142)**	-.0047 (.0195)**
ln (MRM)		.8246 (.2003)		
R ²	.8231	.9161	.9061	.8080
S ²	.0241	.0114	.0055	.0103
T	187	127	108	108

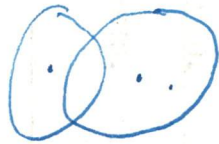
*Not significantly different from zero at the .01 level.

**Not significantly different from zero at the .05 level.

f. As pop. spreads,

Δ air supply not prop. to Δ land supply. Because circles

overlap.



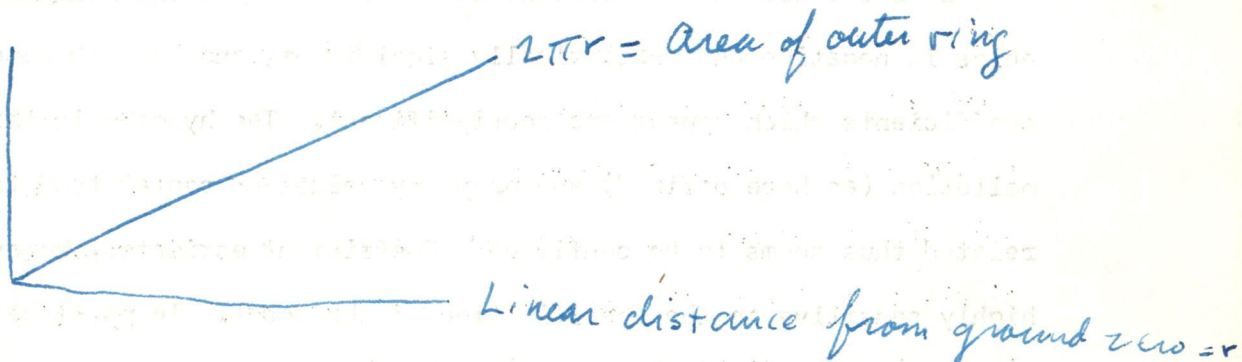
Dependent Independent	Table I SUMMARY OF RESULTS St. Louis			
	Type I	Type II	Type III	Type IV
Const.	3.5407 (.6332)	-1.0705 (.7201)**	.6630 (.4157)	-1.1777 (.5941*)
ln (PSN)	-.1019 (.0340)	-.0412 (.0307)**	-.0034 (.0745)**	-.0132 (.0340)**
ln (PPT)	-.1192 (.0475*)	-.0627 (.0364)**	-.1211 (.0360)	-.0827 (.0403*)
ln (MFI)	.7660 (.0772)	.7598 (.1198)	.5464 (.0592)	.5916 (.0745)
ln (DLP)	-.0802 (.0087)	-.0267 (.0095)	-.0430 (.0065)	-.0656 (.0080)
ln (OLD)	-.0257 (.0162)**	-.0036 (.0126)**	-.0675 (.0196)	-.0805 (.0247)
ln (NWT)	.0373 (.0060)	-.0004 (.0062)**	.0217 (.0048)	.0250 (.0057)
ln (DIS)	-.1387 (.0382)	-.0885 (.0528)**	.0477 (.0248)**	.0335 (.0331)**
ln (MRM)		1.0996 (.2374)		
R ²	.7550	.8767	.8293	.7734
S ²	.0311	.0138	.0105	.0207
T	236	132	174	174

*Not significantly different from zero at the .01 level.

**Not significantly different from zero at the .05 level.

$$A = \pi r^2$$

$$\frac{dA}{dr} = 2\pi r, \text{ is area of small added ring.}$$



$$\Sigma D = \Sigma [D_i \cdot a_i], \text{ where}$$

D_i is damage per acre at intensity i

a_i is no of acres " " " "

It will simplify to note that intensity varies inversely with no. of acres. So this part of product will cancel, leaving a sum based on damage = f of intensity

I = Intensity in ppm

$$D_i = f(I) = f\left[\frac{1}{2\pi r}\right]$$

Assume a circle. Poll. enters at center. Travels at const. speed, ~~rate~~, all directions, diffusing evenly. Inflow into each succeeding ring equals outflow. So each ring contains same amount of effluent (velocity speed depends on air movement, not affected by pressure of effluent itself. If ~~the latter~~ it did depend on pressure, speed wd. fall as you left center, requiring a build up of pressure in each succeeding ring to reach eq. The higher pressure in ea. ring wd. work both

PSN, PPT

In all cases the coefficient of at least one of the pollution variables is negative and statistically significant, and the few nonnegative coefficients which appear are nonsignificant. The hypothesis that air pollution (as here defined) and property values or rentals tend to be inversely related thus seems to be confirmed. Coefficient estimates, however, are highly sensitive to the specification of the model. In particular, estimates usually change quite drastically when forms employing only one pollutant as an explanatory variable are compared with those reported in Table I. This is a symptom of the high degree of intercorrelation between the two measures. Thus, too much significance should not be attached to the magnitudes of coefficients of the individual pollution variables. Taken together, the coefficients imply an elasticity of offer price for owner occupied housing with respect to "composite" pollution of between .1 and .2, or at the mean, a marginal capitalized loss ranging from about \$300 to \$700 per property due to pollution.¹⁹ This same range brackets the elasticity of rents with respect to pollution, and suggests at the mean a marginal monthly rental reduction of \$2 to \$4 per rental property. At plausible rates of interest (say between eight and twelve percent), the results for rental and owner occupied properties are roughly consistent.

When the elasticities and marginal capitalized damages for different cities, or for different parts of the same city (not reported in Table I) are plotted against mean pollution levels, an interesting phenomenon occurs.

¹⁹The marginal damage figures refer to an additional 10 mg/m³/day of suspended particulates plus an additional .1mgSO₃/100cm²/day of sulfation.

ways, i.e. press backwards, too, creating higher pressure in inner rings. Thus a very hi central pressure develops. This is how CBD l.v. develop. But not ~~effluent~~ dispersion - if it depended on pressure differences, never happens, except maybe heat makes it rise.)

P_i = Volume of pollutant in each ring, depends on: i's equal.

P_{ph} = Pollutant per hour, input at ground zero

S = Speed, ~~mph~~ ~~per hour~~, where ~~$v_a \approx 200$~~

A_i = ~~Area~~ in ring = $2\pi r - \pi$.

$$\cancel{P_i = P_{ph}}$$

Each ring has some length of radius, ~~r_i~~ ^{1 mile,} and some P

Area of each ring = $\pi r_n^2 - \pi r_{n-1}^2$

Let r vary by integers. (let the unit be ~~1/4, 1/2, 3/4, 1, 5/4, 3/2, 7/4, 2, 9/4, 5/2, 11/4, 3, 13/4, 7/2, 15/4, 4, 17/4, 9/2, 19/4, 5, 21/4, 11/2, 23/4, 6, 25/4, 13/2, 27/4, 7, 29/4, 15/2, 31/4, 8, 33/4, 17/2, 35/4, 9, 37/4, 19/2, 39/4, 10, 41/4, 21/2, 43/4, 11, 45/4, 23/2, 47/4, 12, 49/4, 25/2, 51/4, 13, 53/4, 27/2, 55/4, 14, 57/4, 29/2, 59/4, 15, 61/4, 31/2, 63/4, 16, 65/4, 33/2, 67/4, 17, 69/4, 35/2, 71/4, 18, 73/4, 37/2, 75/4, 19, 77/4, 39/2, 79/4, 20, 81/4, 41/2, 83/4, 21, 85/4, 43/2, 87/4, 22, 89/4, 45/2, 91/4, 23, 93/4, 47/2, 95/4, 24, 97/4, 49/2, 99/4, 25, 101/4, 51/2, 103/4, 26, 105/4, 53/2, 107/4, 27, 109/4, 55/2, 111/4, 28, 113/4, 57/2, 115/4, 29, 117/4, 59/2, 119/4, 30, 121/4, 61/2, 123/4, 31, 125/4, 63/2, 127/4, 32, 129/4, 65/2, 131/4, 33, 133/4, 67/2, 135/4, 34, 137/4, 69/2, 139/4, 35, 141/4, 71/2, 143/4, 36, 145/4, 73/2, 147/4, 37, 149/4, 75/2, 151/4, 38, 153/4, 77/2, 155/4, 39, 157/4, 79/2, 159/4, 40, 161/4, 81/2, 163/4, 41, 165/4, 83/2, 167/4, 42, 169/4, 85/2, 171/4, 43, 173/4, 87/2, 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and IV, the demand for renter occupied properties is estimated. Types I and II regression differ in that the additional condition is imposed that single family residential units constitute at least seventy-five percent of all housing units in tracts used for Type II regressions.⁷ Types III and IV differ in that the dependent variable in Type III regressions is MGR, while that in Type IV regressions is MCR.

Using ordinary least squares, best precision appeared to be obtained when equations were fitted in the natural logarithms of the model variables.⁸ Without exception, the signs and magnitudes of the estimates presented in Table I are easily reconciled with economic-theoretic considerations. Though major interest and comment is reserved for the air pollution results, the results for other variables do have facets worthy of discussion. In particular, it is severely tempting to speculate on the causes of palpable differences between results for each of the cities. An analysis of covariance of the coefficients for each explanatory variable revealed statistically significant differences from city to city in the coefficients for each explanatory variable. The reasons which could be adduced for these differences are virtually endless, so it will be assumed, in effect, that they are due to structural differences in the residential property markets in the three cities.

⁷This restriction should serve to reduce the variation in variables such as zoning and proximity to commercial or industrial sites, explicit account of which is not taken here due to lack of data. It is likely that these and other similar variables exert a negative influence on property values, and it is also likely that they are correlated with air pollution. It is important, therefore, that they be held as constant as possible in order to reduce the likelihood that measures of air pollution serve only as proxies for these other relevant variables.

⁸In index number applications of regression techniques, log linear forms appear to be the most commonly fitted forms.

Intensity, I_i :

$$I_i = \frac{P_i}{A_i} = \frac{\frac{P_{ph}}{s}}{\pi(2r-l)}$$

$$D_i = f I \times A_i = f \left[\frac{\frac{P_{ph}}{s}}{\pi(2r-l)} \right] \times \pi(2r-l) = f \frac{P_{ph}}{s}$$

Actually, I_i falls faster than area rises, bcs. there is vertical dispersion, too. Also, angle of dispersion Δs w. dist. from source. Of course, this last doesn't alter the cancellation above. It just means that area rises faster, and intensity falls faster, with Δr .

$TD = \# D \text{ per area} \times \text{area}$. As Δr rises w. lower intensity, ~~the~~ TD rises. Then it falls. ΔD is a simple key.

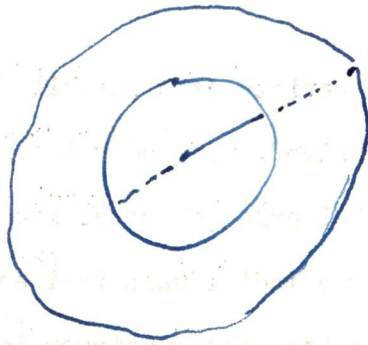
In accordance with the arguments of the two preceeding sections, median family income (MFI) and existing stock of housing (ALL) are employed as explanatory variables in our work. Since each observation of the income variable is a measure of central tendency, it is assumed that transitory income is roughly zero and the MFI therefore represents permanent income.

As noted above, tracts are designated so as to encompass roughly the same number of units, so it is unlikely that the ALL variable will have much explanatory power; that is, ALL is roughly constant both in the market and in the sample.

In addition to the variables discussed above, all of which are carried through the regressions reported in the next section, a great number of other plausible explanatory variables were tried where data were available. Among them were crime rates, property taxes, per capita school expenditures, measures of neighborhood homogeneity with respect to occupation and schooling, absolute measures of educational attainment, population and residential unit density, proportion of units in each tract having basements, and others. Inclusion of these variables and various combinations thereof did not greatly change the results reported in the next section, and since coefficients for these other plausible variables were almost uniformly nonsignificant, no results are reported for forms predicated on their inclusion.

IV

Regression results for the three cities are presented below in Table I. Four regressions, designated Type I, II, III and IV, are reported for each city. For all four regressions, only tracts for which population exceeded one person per acre are included in the data. In Types I and II regression, the demand for owner occupied properties is estimated, whereas in Types III



$$r=1$$

$$2r-1 = 2-1 = 1$$

$$r=2$$

$$2r-1 = 4-1 = 3$$

By similar reasoning, a variety of plausible negative relationships between NWT and MPV may be derived. To muddy the matter still further, Schelling suggests that spatial arrangement of racially different individuals may be more relevant to the way individuals feel about their environment than simple gross proportions, and that whatever individual preferences are for racial mixture, in the absence of concerted action, the tendency is toward a high degree of segregation [30]. This could suggest relatively low values for properties in the generally unstable midranges of racial mixtures and higher values at the extremes, or it could suggest relatively low values at the extremes because nobody may be as satisfied at the extremes as with some ideal midrange mixture. In general therefore, it seems best not to infer housing discrimination or the absence thereof from the sign assumed by the coefficient of the nonwhite variable.

In accordance with long established tradition, distance from the central business district (DIS) is also included as an explanatory variable. In these traditional studies, a site located away from the center incurs, cet., par., a penalty in the form of higher transportation and communication costs, which are presumably capitalized negatively into site values. However, as Harris, et. al. [8] and Rothenberg [28] have recently pointed out, the amenities available only outside the central city can outweigh travel and communication costs in family residential site choice, so that the DIS variable may capture the influence of some amenities of suburban living which are, due to lack of data, not included in the model.

As a measure of housing space and the privacy which a structure affords, median number of rooms (MRM) is employed as an explanatory variable. It is to be expected that this variable exerts a positive influence on offer prices.

When we consider that much escapes upwards, the picture changes drastically. Now my old implicit model becomes more relevant, where spreading out does no good bcs. ave. effc. of pollutants rises. Area affected now is not Δd by $\Delta P \phi$.

Can dilute by dispersing sources - this genuinely Δs area affected, and this in turn reduces its effectiveness.

So: if P escapes upwards, dispersion is no help.

if P escapes horizontally, dispersion may help some.

But overlapping of circles cancels much benefit.

if sources are totally segregated (w. horiz. exhaust) there is a gain.

change (which is admittedly slow in housing) causes obsolescence of older units. As is well known, depreciation and obsolescence act so as to bring closer to the present the time at which the house will be replaced or demolished. Presumably because the potential rates of depreciation and obsolescence in these later years of useful life are greater than for newer properties, mortgage lending agencies typically accentuate the impact of age upon property value by charging higher effective interest rates, by requiring larger down payments, or by shortening maximum repayment periods.

The explanatory variable NWT represents the proportion of occupied housing in each tract inhabited by nonwhites. It is not clear what sign to expect for the coefficient of this variable. There are, in fact, at least two very different reasons why this variable might assume a positive coefficient, each of which has to do with the way individual demands are aggregated up to the tract level. First, if pricing is discriminatory as is commonly alleged, with nonwhites paying higher prices for properties than would whites for the same properties, NWT exerts a positive influence since as the proportion of people in a tract paying a relatively high price for a property increases, so also does the median property value for the tract. Discriminatory pricing in the housing market cannot exist, of course, without collective action, so that at base, this kind of relationship between NWT and MPV is only indirectly connected to individual offer functions. Second, if nonwhites attach a premium to living apart from whites, whereas whites are indifferent or discount willingness to pay because of the presence of nonwhites less than nonwhites augment willingness to pay, NWT and MPV again tend to be positively related. In this second case, in contrast to the first, the positive relationship is directly related to individual preferences.

To Mr. Gaffney

Date 12-16 Time 12:10

WHILE YOU WERE OUT

Miss Krause

of fortune magazine

Phone 212 556-7620
Area Code Number Extension

TELEPHONED	☒	PLEASE CALL	☒
CALLED TO SEE YOU	☐	WILL CALL AGAIN	☐
WANTS TO SEE YOU	☐	URGENT	☐
RETURNED YOUR CALL		☐	☐

Message _____

do

Operator

Mr. Gaffney

December 12, 1969

A Miss Krause of Fortune Magazine telephoned to say that she and a Mr. Sanford Rose would like to come and discuss certain pollution problems with you, having been referred to you by numerous people whom they have already interviewed, in connection with an article for Fortune.

I have tentatively arranged for them to come and see you on Wednesday, 17 December at 11.00 a.m. Miss Krause will telephone on Tuesday to confirm this.

The specific points they would like to discuss are:

1. Pollution control by various methods--taxation, subsidies, waste charges.
2. Which are the most efficient economic controls?
3. What are the economic structures that would facilitate technological change?

Kavir

Sanford Rose, re pollution

1. Compact cities.
2. Untax distr. of power, gas.
Fed. level. Mine-mouth power. Make coal mobile.
3. Apply controls to old as well as new.
London & soft coal.
4. Air & wtr. as public domain. Pay the public - solve polln. conundrum.
5. Ignore ~~purist~~ quibblers who idolize inaction.
5. Tax autos; subsidize mass transit.
6. Bounties to get measuring devices.
7. Polluter has easement over surrounding land -- shd. pay.
5. A auto tax w. characteristics assoc. w. polln.
age
size
~~Acquired~~? Certain makes, models
8. Use tax system to compensate losers from winners.
9. Empl. problem. Create empl. by fighting polln.
10. Tax favors are good, but distorting.
Are better as part of general policy to untax capt. -- both by inc. & prop. tax.
11. Abandon ad valorem fuel taxes. Rank fuels by polln. danger, tax in that order.

12. Now, if subit. new clean gas or electric heat for coal, taxes rise.

Reshape tax system -- doesn't make sense anyway.

Coal, stored in open, no tax.

13. Dispersal? Not in goal.

Disperse polluters

Concentrate others. Protect highest quality environment in center.

14. Where ~~discharge~~ air exhaust is vertical, concentrate pollution, to min. area affected.

Using high stacks, area nearest source is best protected.
No use high stacks in center.

~~13~~

13. By concentrating receptors, enable putting polluters near in yet still beyond receptors. E.g. refuse dumps.

When scatter receptors, can't get polluters away from them, have to mix all together.

14. Fast replacement.

St. Louis puts pollution police on trail of offending motorists

Special to The Christian Science Monitor

St. Louis

St. Louis drivers are finding that the flashing red light on that police car trailing them doesn't necessarily mean they have just exceeded the speed limit. They may have violated the city's air-pollution ordinance.

Thirty-five specially trained police officers are ticketing drivers whose automobiles and trucks lay down smoke screens. The officers underwent intensive training to help determine when drivers are violating the new law.

The ordinance prohibits the emission of exhaust fumes so dense that 40 percent of light intensity cannot pass through them. This equates a reading of 2 on the Ringelmann Chart, a device with shadings from gray to black used to read smoke emission.

The emission of such dense exhaust for more than 10 seconds from a standing automobile or for more than 100 yards from a moving car is a violation subject to a fine of \$1 to \$500 and 90 days in jail.

First violators generally are being fined \$10 and court costs.

At the conclusion of one of the training sessions, an officer raised his hand. "Just one question," he said, directing it to Charles M. Copley Jr., city Air Pollution Control Commissioner. "Will it hold up in court when a lawyer gets up there?"

"One never knows until one tries," Mr. Copley replied.

His deputy commissioner, Paul Mydler, conducted the practical lessons on reading smoke emissions. A calibrated smoke generator, producing any desired density, was used.

Training amounted to a 24-hour course

riots, ... to ...
best roads to solving city problems for a very good reason: it cuts across economic, and class lines. Representation of particular interests, it involves top leadership in a total approach.

Nothing less appears adequate to the problem, though there are skeptics who doubt that even this is enough, or in time.

in the use of Ringelmann and equivalent systems, which enable visual determination of smoke emissions on scales ranging from zero to 100 percent density.

Only one of the 11 tickets issued thus far has been contested in court, and the case was continued.

Cpl. Howard J. Bigley of the police radar unit noted that "cold weather is making it a little more difficult to read the smoke so we have to be a little more careful."

Patrolman Eugene L. Siewing of the truck-taxi unit added that steam emitted from automobiles in cold weather also makes reading emissions more difficult.

Publicity given the air-pollution-enforcement program evidently jogged some trucking firms into making needed corrections, he said.

Jakarta communiqué

By the Associated Press

Jakarta, Indonesia

Philippine President Ferdinand Marcos and Indonesia's acting President, General Suharto, have signed a communiqué calling for closer cooperation among members of the Association of Southeast Asian Nations.

They recommended a joint commission to study ways their countries might be of immediate economic help to each other and expressed support for the association as the most effective instrument for achieving progress, stability, and good relations among the states of the region.

President Marcos, winding up a three-day visit, invited General Suharto to visit the Philippines.

are the riot the days of

The community about who was talking: office 'v treats n trations sitting

I think make t will be groups

I'm n we're go understa there's g a way p something I want t

Q. W the mos

A. V can ha someth talk ab someth ple to altern

Q. gram

A. novati citizen mitted to hel

I'm that i dren. want that's We and today

Q. tow bor

I wh



"HORSE": Monochrome
by Soga Shōhaku

ing though he was, the
Laughs at Tiger Creek," and
is most conscientiously drawn. So
his "Horse," left; a single pane
almost life size. This is, nevertheless,
more in his wildly vigorous style. In
it he combines boisterous strength
with delicious sensitivities.

Thirty of Shōhaku's paintings, long
hidden from public view due to in-
adequate gallery space, have been
brought out at Boston's Museum of
Fine Arts. They show that Shōhaku
was at his best in an unusually large
format. Drawn from the Museum's
crowded storerooms, these works
comprise the world's largest collec-
tion of paintings by Shōhaku.

PATRICIA BOYD WILSON

But
On a few se
Intense in brillian
Your moment shines.

Then why are you still sulking in t
The House is packed.
What's all this talent you are holdin
On stage. Before the treacherous C
Down, speak your lines.

Rules for the constitutional conv

The Rules Committee had done its
work over the weekend; George
Wythe of Virginia rose with his re-
port. At sixty, Wythe looked like a
sinewy old eagle. A long sharp nose
nearly met a jutting chin, the head
went into a point at the top. Wythe's
eye was keen, his forehead deeply
lined. Chancellor Wythe, he was
called, because of his position in the
Virginia courts. In Williamsburg his
neighbors referred to him as "the
Just" and said he was another Aris-
tides. Wythe had signed the Declara-
tion of Independence and helped to
design the state seal of Virginia with
its defiant motto, *Sic Semper Tyrann-*
is. He was a notable classical
scholar and served as first professor
of law at the College of William and
Mary. Although he left the Conven-
tion early, Wythe's influence was
felt; he supported a strong national
government.

The Convention rules were simple
and took account of courtesy as well
as convenience. It was an age of
formal manners; an old Connecticut
charter had specified that a voter
must be "of quiet and peaceful be-
havior, and of civil conversation."
"Every member," read Wythe,
"rising to speak, shall address the
President; and whilst he shall be
speaking, none shall pass between

them, or hold discourse with another,
or read a book, pamphlet or paper,
printed or manuscript. . . . A mem-
ber shall not speak oftener than
twice, without special leave, upon the
same question; and not the sec-
ond time, before every other,
who had been silent, shall have been
heard, if he choose to speak upon the
subject. . . . When the House shall
adjourn, every member shall stand
in his place until the President pass
him. . . ."

Seven states were to make a
quorum, and all questions to be de-
cided "by a greater number of these
which shall be fully represented."
There was an excellent rule providing
for reconsideration of matters that
had already been passed on by a ma-
jority. Young Spaight of North Caro-
lina suggested it: "The House may
not be precluded, by a vote upon any
question, from revising the subject
matter of it when they see cause."
Again and again, in Committee of
the Whole, the rule would go into
action and a subject already voted
upon would next day be reconsidered.
Rufus King made this procedure the
more effectual by objecting to a rule
authorizing members to call for the
yeas and nays and have them entered
in the book. It would be binding to

VICTOR HOWES

steel mills: new rain producers

TO DATE, METEOROLOGISTS have yet to satisfy all the people all the time in weather forecasting. Sometimes, inevitably, "fair and warmer" turns out to be cloudy and colder.

Residents of LaPorte, Ind., and Stanley A. Changnon, a climatologist for the Illinois State Water Survey Dept., agree that that small Hoosier city has a special weather problem and that its solution may contribute substantially to weather modification efforts in the future.

For the past several years, LaPorte has averaged 31% more rainfall than nearby areas; 84 days of hail between 1951 and 1960—compared to only 43 days for other communities within a radius of 160 kilometers; and thunderstorms that have increased by 38%. Adding to the mystery, LaPorteans reported several early morning thunderstorms—a phenomenon usually reserved for afternoons and evenings.

Changnon points out that his investigations show a substantial relationship between hazy conditions over the steel-producing Calumet area near Chicago's South side and Gary and the strange weather in LaPorte.

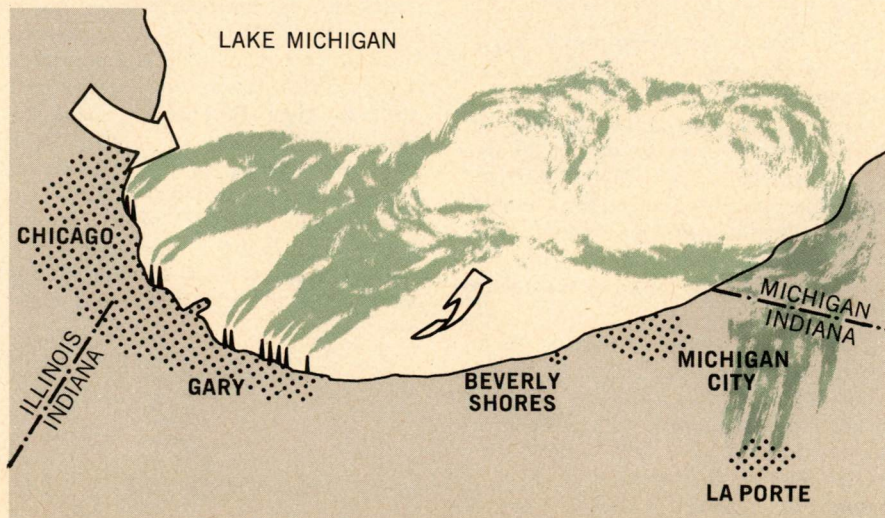
"It seems that air pollution from

the Calumet area triggers the unusual rainfall, thunderstorms, and hail at LaPorte," he explains.

Since 1925, when the steel industry moved into full swing, residents have experienced increasingly unpleasant, wet weather. LaPorte is 30 miles east of the industrial area, and 10 miles south of Lake Michigan. Apparently this is exactly the distance needed for windborne pollutants to combine with moisture from the lake and eventually fall in various forms upon LaPorte.

Changnon explains that the heat maintained throughout the night in the industrial-urban area pours increased heat into the atmosphere. Added heat causes greater vertical air motions, with cloud and rain development. Pollution particles in the air then allow for more rapid growth of raindrops. Added water vapor increases moisture needed for cloud development, and it all culminates in precipitation above LaPorte.

But even in these clouds, science sees silver linings. If all this industrial smog can create a soggy society in LaPorte, why not apply the principles to help create rainfall in arid areas? □



1-R ILLUSTRATION

CHICAGO'S METEOROLOGICAL TARGET

LaPorte hits the jackpot in rain, thunderstorms, and hail

AND THEN THE DECADES INTO POLLUTED JUNKIES

weather watchers

TORNADO WATCHERS in this country's "disastrous weather belts" may find some solace in results from an ESSA/NASA experiment—but not right away.

In essence, NASA's multicolor spin-scan camera already aboard the Applications Technology Satellite (ATS 3) now in synchronous orbit will be used to take pictures of the Northern hemisphere at 15-minute intervals on days of suspected tornadic activity.

Photos from the first tests will not be available in time for warnings, but if the theory proves out, NASA says, the next step is to provide the pictures in time for actual storm forecasting and warning procedures. □

CHEMISTRY

some versatile beads

MAN HAS YET TO LAND ON MARS—let alone approach it very closely for detailed analyses. But scientists already are preparing for on-the-surface examination through specialized instrumentation.

Meanwhile, as is often the case with such development work, surprise innovations applicable to immediate work here on earth are a welcome spinoff. One such spinoff involving porous polymer glass beads may turn out to be one of the more promising advances in gas chromatography made in recent years.

Scientists at Jet Propulsion Laboratory in Pasadena, Cal., were busily engaged in R&D to provide an atmosphere analyzer slated for landing on Mars' surface sometime in the 1970s. The group led by Dr. W. F. Wilhite, of JPL's Space Sciences Div., needed a gas chromatograph column that could separate a dozen or more atmospheric components in less than 15 minutes.

When the program started, there were no conventional packing materials capable of performing the desired multi-component separation in a single column. At this point, JPL heard of the development of a new packing material by Dow Chemical Co.'s Basic Research Laboratory, Freeport, Tex.

Preliminary tests were run off at Dow using several different kinds of

short (5.1 centimeters) length of Porapak R to the 1.8-meter Porapak Q column. However, the operation took a long time—52 minutes—and even then nitrogen and CO₂ were not separated.

JPL continued the tests, varying bead materials and using more polar types to achieve additional resolutions.

After several months, a column was assembled that accomplished the task in about 14 minutes. It consists of 2.44 m of 50-80 mesh Porapak Q in series with 2.44 m of 50-80 mesh Porapak R with an overall column inner diameter of 25 millimeters.

This system resolves the following: hydrogen, nitrogen, carbon dioxide, methane, water, nitric oxide, nitrous oxide, nitrogen dioxide, ammonia, methyl fluoride, methyl chloride, hydrogen sulfide, and sulfur dioxide. Oxygen, carbon monoxide, and argon monoxide are not resolved, but these can be detected easily by mass spectrometer. □

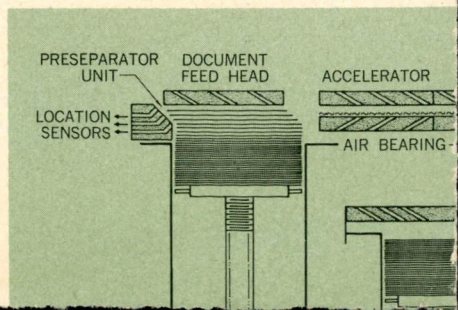
INFORMATION STORAGE

fluidic-magnetic

AN ALL-FLUIDIC transport system and a magnetic data card are the key to a new records processing system, believed to be inherently more reliable than familiar mechanical equipment.

A potential replacement for the punched card, the new storage unit is a polyester plastic card measuring 6.3 x 10 centimeters. It is overcoated on both sides with a thin nickel-cobalt magnetic film. Because the card accepts inks applied by conventional means, it can accept both man-readable and machine-readable data.

Developed by the Univac Div. of Sperry Rand Corp., Philadelphia, for the Army Electronics Command, the card can store 1,000 machine char-



A plan for India

Can man unmake a desert?

By Robert C. Cowen

Natural science editor of
The Christian Science Monitor

San Francisco

Lack of rain, drying winds, and sunny skies create deserts. Sometimes man helps out too.

In Northwestern India, man gets most of the credit for the Rajputana Desert. Because of this, Prof. Reid A. Bryson of the University of Wisconsin thinks man may be able to make that desert bloom again.

Wisconsin's Center for Climatic Research, which Dr. Bryson heads, works with the Indian Government and with other American agencies in exploring this possibility of reversing a centuries old, and disastrous man-made climatic change.

Discussing this here shortly before heading out to India, Dr. Bryson said that the Rajputana has no business being a desert. It might naturally be semiarid. But it shouldn't be a thoroughgoing, agriculturally poor desert.

Too much moisture

Among other things, the air holds too much moisture. It has enough water vapor to make a water layer four centimeters thick. Air over the wettest place on earth has only about five centimeters of precipitable water. Most deserts have about one centimeter.

So, waterwise, the Rajputana should be fairly well off, if only it would rain more often. But men, thoughtlessly, have tipped the delicate atmospheric balance against rainfall.

Desert air generally suppresses rain because it sinks slowly downward over large areas. In sinking, it warms because it undergoes compression in moving down to higher pressure. This both lowers the air's relative humidity and discourages rain-forming processes. These involve rising air.

While the air warms under compression, it sinks because it loses heat through radiation. Over the Rajputana, air sinks much faster than radiative cooling of normal air would allow. This, Dr. Bryson explained, is where man has intervened.

Dust bowl created

Poor farming practices, beginning thousands of years ago, created a dust bowl. This has filled Rajputana air with enough dust to substantially speed up the air's rate of sinking.

Dr. Bryson said that measurements made



By the Associated Press

Dusty travelers

there in 1966 indicate the air holds $5\frac{1}{2}$ tons of finely divided dust per square mile. This changes the air's heat radiation so it cools faster than clean air. He calculates that, because of this, the air sinks 50 percent faster than it would if it were clean.

Although he can't prove it, Dr. Bryson said evidence suggests that a people called the Harappans started this trend. They once had a flourishing agriculture in the Rajputana. But, about 1500 B.C., they disappeared.

The Harappans kept cows and pigs and grew grain. Dr. Bryson envisions them arriving in a pleasant grassy land. They found abundant grazing for their livestock. They had good crop yields, up to a point.

More grassland destroyed

Then, with the grass destroyed, dust began to swirl. Filling the air, it speeded up atmospheric cooling and subsidence. The climate became drier. This enhanced dustiness. It forced the Harappans to tear up yet more grassland to maintain their food supply.

Thus the dustiness induced a drier climate,

Dr. Reid A. Bryson of the University of Wisconsin think this desert area in India can be made green pasture again. These Indian women are carrying water jars to a well six miles from their village.

which spurred more poor land management and more dustiness, which intensified the aridity, and so on. This, eventually, forced the Harappans out, in Dr. Bryson's theory. Attempts to eke out a subsistence living from this abused land since then have perpetuated the desert.

Dr. Bryson and his colleagues wonder whether they can reverse the self-reinforcing cycle he thinks the Harappans started. The United States Navy, Weather Bureau, and National Science Foundation, together with the Indian Government, several years ago launched a project to find out. That is the project coordinated through Dr. Bryson's center.

Whether or not this will succeed remains to be shown. But, Dr. Bryson said, it does look as though the land will revert to grassy prairie if left unmolested. When goats and other livestock are fenced out of an area, grass springs up naturally.

Perhaps, Dr. Bryson said, with grass tying down the dust over a big enough area, the air will clarify. Then it may cool less and subside less. This, in turn, may favor higher rainfall. Then, with wiser farming practices, the Rajputana might live again.

Forgiving enemies

Written for The Christian Science Monitor

Joseph, the son of Jacob, is one of the most lovable characters in the Bible. Why? Because he expressed Christliness. This made him successful in all his ways. Joseph had great humility, moral courage, and resourcefulness. He spontaneously turned to God in his many tribulations.

One of Joseph's most endearing qualities was an ability to forgive. He bore no ill will against his jealous brothers, who sold him into slavery. He did not dwell on this injustice but went forward, willing to do whatever God wanted him to do.

Joseph refrained from exposing and denouncing Potiphar's wife when she falsely accused him. Although he was cast into prison as a result of his stand for moral integrity, again he did not dwell on the wrong done him but set about trying to serve his fellow prisoners. This God-given desire enabled him to interpret correctly the

dreams of a butler and baker of Pharaoh.

Later, by interpreting Pharaoh's dream and then saving Egypt from famine through his wise provisions and acts, Joseph showed more of the great wisdom and foresight that God gives those who obediently express His goodness. A final proof of Joseph's loving and merciful nature was his full forgiveness of his brothers, whom he tenderly embraced and provided with food supplies when the famine forced them to seek aid in Egypt.

Students of Christian Science soon learn the wisdom of not bearing resentment for real or imaginary wrongs done to them. They know that entertaining resentment will do them more harm than any injury. The renouncing of all desire to seek revenge invokes divine power, thus helping to right a wrong.

In her work "Miscellaneous Writings," Mary Baker Eddy, the Discoverer and Founder of Christian Science and author of "Science and Health with Key to the Scriptures," writes (p. 12): "If you have been badly wronged, forgive and forget: God will recompense this wrong, and punish, more severely than you could, him who has striven to injure you."

The Bible counsels people to love their enemies. Does this mean that they are to love even the evil traits expressed by their enemies? No! According to Christian Science, they must separate bad traits from the identity of one who seems to express them and love his true selfhood. They must recognize him as actually God's man, the image and likeness of divine Love. They must free their thought of the misconception that man is com-

Cristiana, deben separar las malas características de la identidad de aquel que parece expresarlas y amar su verdadera identidad. Tienen que verlo realmente como el hombre creado por Dios, como la imagen y semejanza del Amor divino. Tienen que liberar su pensamiento del concepto equivocado de que el hombre está formado de carne, sangre y huesos—en otras palabras—de que el hombre es un mortal, y mantener el verdadero concepto del hombre como enteramente espiritual. El hombre, creado por

Both pictures by courtesy of Galeria Rubbers, Buenos Aires

Oil on canvas by Vicente Forte

Perdonando a los enemigos

[This is a Spanish translation of "Forgiving enemies," appearing on this page]

Traducción del artículo religioso publicado en inglés en esta página
[Una traducción al español aparece tres veces al mes]

José, el hijo de Jacob, es uno de los personajes de la Biblia más dignos de ser amado. ¿Por qué? Porque expresó la naturaleza semejante al Cristo. Esto hizo que triunfara en todos sus caminos. José poseía gran humildad, valor moral e ingenio. En las muchas tribulaciones por las que pasó, se tornó espontáneamente a Dios.

Una de las cualidades más dignas de ser amadas que poseía José era su habilidad para perdonar. No abrigó

decades Vicente Forte a firm place in the of art. The two still e typically and indi- his cubist tendencies. sional element is ac- asco Extraño," "The (below) stands, how- tracted, hollowed-out, a base. Rectangles of outlined in ridges of p, and the shadowed e guitar from being There is some optical e table's edge, for the upright on what is ical.

a Las Frutas" or Fruit" is a delight- sign. From a verti- rs — palest green, and sand—a bird a window, to the

US Toughens Rules on Pollution by Cars

By LAURENCE C. EKLUND
Journal Washington Bureau

Washington, D. C. — Wilbur J. Cohen, secretary of health, education and welfare, Monday issued new and stronger national standards for the control of air pollution from motor vehicles.

The new standards apply to 1970 model year motor vehicles. They cover imported as well as American made passenger cars, trucks and busses and include diesel powered motor vehicles for the first time.

Cohen said the new limitations brought the nation another step closer to the goal of effective control of this major source of air pollution.

"I hope that application of

the new standards will stimulate a renewed effort to find improved ways of controlling emissions from motor vehicles," he said.

Two Pollutants Covered

"Protection of the public health and welfare will no doubt require that more stringent standards be adopted in the future," he added.

These standards, issued under provisions of the air quality act of 1967, apply to two of the most important motor vehicle pollutants — carbon monoxide and hydrocarbons.

All the carbon monoxide and about 60% of the hydrocarbons that automobiles release into the air are discharged through the tailpipe.

The new standards will re-

duce the exhaust tailpipe emissions by about 30% below the limits now in effect on 1968 and 1969 model cars.

Such emissions will be limited to 23 grams of carbon monoxide and 2.2 grams of hydrocarbons per mile of driving, as compared with 34 and 3.3 grams under the standards on 1968 and 1969 models.

No Problem Foreseen

If not equipped to control air pollution, the average passenger car would discharge 73 grams of carbon monoxide and 11.2 grams of hydrocarbons per mile.

John Middleton, director of the welfare department's national center for air pollution control, said meeting the

more stringent emission control standards for the 1970 model vehicles should pose no problem for the industry.

The 1968 model vehicles, he added, performed "extremely well" in meeting his agency's certification tests, and 90% of the 1968 models tested produced emissions significantly below the current standards.

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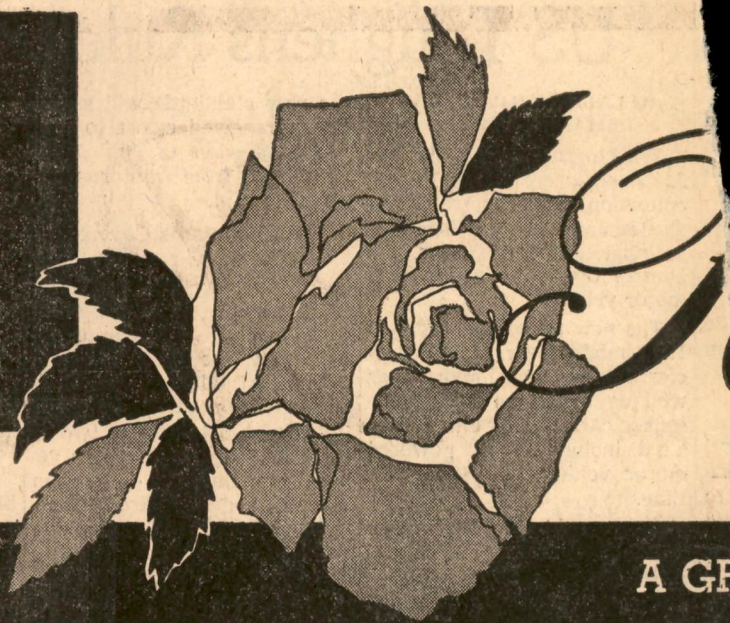
Peace Festival

Part 1

Tuesday, June 4, 1968

THE MILWAU

Gimbels
★
Schusters



A GRE

NOW! YOU SAVE 33%
IN OUR BIG ANNIV

Polln. damage not analogous to auto congestion, range congestion. Their damage frs keep rising faster, & MC rises continually, but there are more cars or cattle there to damage. But pollutants don't damage each other.

∴ opt. effluent charges do not rise continually w. congestion. They are max. at middle density.

✓ Time: if city is twice as large, but pollutants spend twice as long getting out, no gain.

Reducing duration (& freq.) of exposure is a good approach - more than one way to skin a cat.

✓ Cones of dispersion. Smoke plumes fan out. At first the dilution helps none -- AP rises. To ^{compact} ~~small~~ city, it gets out of town before AP gets as hi

✓ Load factors. Polln. control better in larger centers.

User charges are a tax.

Growing sentiment for selective user charges. Not broad based, but = MC

Environmental improvement implies space. But econ. has ~~not~~ been spaceless. So, much needs to be done.

New Anti-Pollution Suit Hits Auto Industry Big 3

CHICAGO (AP) — A \$3-billion damage suit has been filed against the Big Three auto manufacturers, charging that they conspired to delay development of anti-pollution devices on cars, trucks and buses.

The suit filed in U.S. District Court yesterday alleged that Chrysler Corp., Ford Motor Co., and General Motors Corp. had conspired since 1953 to "restrain trade in the distribution of motor vehicle air pollution control equipment."

A similar suit was filed in California by the Justice Department last January. But Atty. Gen. John N. Mitchell announced last Thursday in Washington that agreement on a consent decree had been reached in that case, which in effect amounted to abandonment of the suit.

Filed by Aldermen

Defendants in the government action in U.S. District Court in Los Angeles were the Big Three, American Motors Corp., and their trade association, the Automobile Manufacturers Association.

The Chicago suit was filed by

two city aldermen, Paul T. Wiggoda and Thomas E. Keane, as private citizens on behalf of all Chicagoans. Keane is Mayor Richard J. Daley's floor leader in the City Council.

Keane said agreement on the California case was one reason the taxpayers' suit was filed in Chicago. Mitchell's announcement last week had brought protests from 18 members of Congress.

Won't Face Trial

The California decree will take effect if signed by a judge within 30 days after being submitted. If approved, the decree would prohibit the manufacturers from taking part in any conspiracy to delay development of anti-pollution devices, but they would not face trial.

Specifically, the Chicago suit charged that the Big Three conspired to eliminate competition and research on the subject; purchased available pollution control patents; and delayed installation of pollution control devices on cars.

The manufacturers association and seven smaller car manufacturers were named as coconspirators in the suit.

Re Oregon air polln.

Valley is problem.

North wind prevails, polln. collects at Eugene, packs in tight.

Major sources:

Open burning of refuse. City dumps.

Backyard burning barrels.

Slash burning, (post-logging clean-up)

Straw burned by grass-seed farmers.

Space heating - oil

Wigwam burners

Metallurgical plants

Biggest source: Auto. Maybe 63%.

Aug. '69 new house bill 1481, new & higher norm of air quality.

Oregon Environmental Quality Comm.

Bias for single-fam. home: (Mower philosophy)

- It may burn refuse in open air, still. (In Portland reg.)

- Autos not regulated

Columbia. Willamette regional air polln. authority undertaking master study of air to predict where concentrations of polln. will build up.

This shows they believe damage fvs. are in Δg returns. Maybe this is wrong, & they shd. concentrate them, having regional specialization. Thus reduce area affected.

Local regional authority encourages new plants, but they have to come in clean. Then, double standard. Old grass burning & wigwags are treated lighter. Are trying to avoid driving grass burners out of bus. That must be faced up to.

Sulfite mills are converting from batch process to vat system so SO_2 can be recovered, not blown into air. (no tail-end Charlie here.)

Mosses philosophy, get big sources, ignore auster & homes. But looks forward to hitting them. & also going to rapid transit & effluent charge on stocks.

1. People get rich ^{or stay lazy} by invading commons. Am. Tradition, Function -
Indian fighting. Not apply to em.

2. User charges

3. Distrib. important

can kill you, if don't handle.

in, public domain

Judge recently said law can't touch smog (auto case).

1. ~~Invading~~ Resource-using operations are the problem.

4. Open access is the problem. Dissipation of ec. rent.



CORVALLIS, OREGON 97331

OREGON STATE UNIVERSITY

AIR RESOURCES CENTER

June 23, 1969

Professor Mason Gaffney
Department of Economics
University of Wisconsin; Milwaukee
Milwaukee, Wisconsin

Dear Professor Gaffney:

The National Air Pollution Control Administration, Division of Economic Effects Research, has recently awarded Oregon State University a contract to investigate the social and economic effects of open field burning of agricultural waste and the practice of slash burning in forested areas along the Willamette Valley of Oregon. During the academic year 1969-70, participants in the O.S.U. Continuing Seminar on Economic Aspects of Air Pollution intend to specify (1) a benefit-cost framework for the evaluation of alternative means of air pollution control and (2) a set of research projects for determining the benefits and costs to various groups of residue disposal burning practices in the Willamette Valley. In future years members of the seminar plan to conduct systematic benefit-cost evaluations of alternative abatement policies.

The major task of the seminar during the fall and early winter of 1969-70 will be the specification of a conceptual model suitable for the evaluation of the economic consequences of pollution from the burning of the residues from agricultural and forestry operations. To assist the seminar in accomplishing this objective, invitations are now being extended to various economists to spend two days here next fall. A formal seminar presentation is expected to be combined with fairly extensive informal discussions about pollution problems. We will pay an honorarium of \$200 per day, plus expenses.

I am inquiring, therefore, whether your schedule for this fall would permit a visit to Corvallis and participation in this program. As you can understand, an early reply would be appreciated.

Sincerely yours,

R. Charles Vars, Jr.

R. Charles Vars, Jr.
Assistant Professor
of Economics



Mon. Call Blair for coaching.
On John 503-754-2944 OSU.
Del Olympia?
trv H. RCV/mp

Gulf General Atomic talk, July 22, 1968
pp. 1 & 2 are my intro -- ~~what~~ what is now common in the field.

1. My thinking has been geared more to public policy, rather than direction of research.

~~However~~, so interupt, & think out loud together,

My experience w. natural scientists has made me less diffident. They need us.

2. ~~For~~ Nature of ec. anal.

Not pecuniary. Man & the machine.

Travesty of econ. But economists are responsible, too, deserve their image.

Arbitrate. Fundamentalists. Hard & soft.

Gale man half time. Samuelson, ~~lowering~~ lowering ave.

Trade off. Preaching to converted here?

Opt. intensity of factor inputs. Shd. help find opt. public control.

Redistrib. mechanisms. Justus, social, for getting things done.

Space, time -- been neglected.

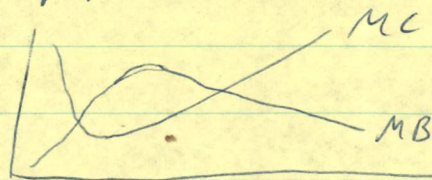
Tenure, property -- ~~prop~~ rts. to pollute, & be unpolluted.

Vested interests. Inell. orgs.

Taxes & motives.

3. Some general models for framework of analysis.

a. Limits of public control: div. returns, Δ g in pub. costs



Air quality in a perimeter

Steps in putting together such a "payoff" graph (subassemblies)

At any step, can contribute. Don't have to do the whole job. Lots already

- | | |
|---|---|
| i. <u>Measmt. of flue emissions</u> . St. Louis. <u>Measmt. is science</u> . <u>Measmt. is social control</u> . | } working on part of it.
Not vertically integr.,
like int'l. margin oil co. |
| ii. <u>Flue emissions as $f(\text{control costs})$</u> . At various scales; Various lives (need to know life, need to forecast obsolescence) | |
| iii. <u>Ways to control</u> . <u>Budgets</u> . <u>Process modification</u> . Tail end <u>Chimneys</u> . Etc. <u>Batteries</u> . <u>Trade-offs</u> . | |
| iv. <u>Ambient air quality as $f(\text{flue emissions})$</u> | |

(Spatial aspect, see 3, b)

v. Synergistic reactions, photochemical

Mgnl. imputation of cause & effect. Not hopeless.

Like imputing mgnl. prod. to workers. Euler.

vi. Damage as $f(\text{ambient air})$.

Esp. human damage. Medic., psycho.

vii. Ec. cost of damage

May short circuit (vi). accept arbit. judgments. A.L.V. Hard to msre, but prof. ~~some~~ developers do it.

Distribn. of damage among diff. areas, people. (For possible weighting -- by L.V., by density, by inc. ...)

Many aspects of costing (ii). Give special attn. to one, now.

Is i. Very hi. Going to stay hi.

So emphasis on trade-off betwn. capl. costs & op'g. costs.

Reduce capl. costs. Investor can't expense them, as he can R&D.

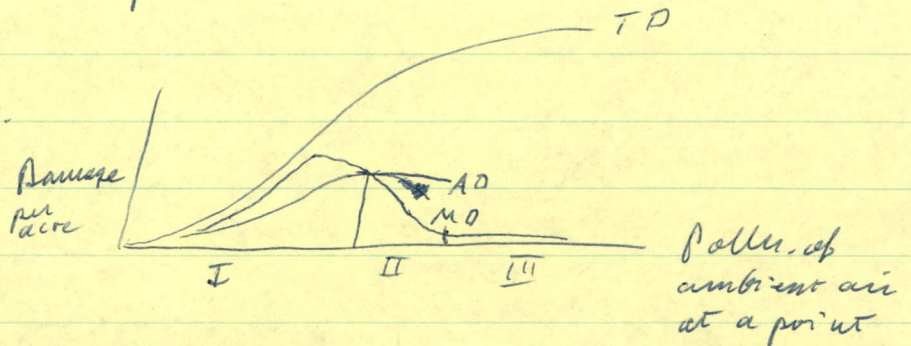
This is about as far as accepted frameworks go -- this is what people are working on.

b. Spatial aspects of pollut. control.

Poll. cont. is enhancing "environment": = Space.

Ecs. is weak here - needs work. Maybe a step in which pot. research can be productive.

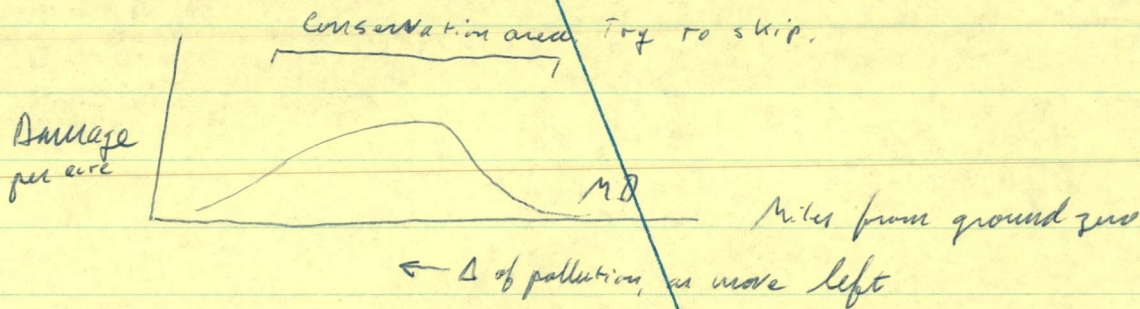
Hypoth. damage fun.



Goal: to min. efficiency of pollutants in producing damage.

Avoid max. AD. - An unhappy medium.

But has a spatial aspect. Pollut. intensity grades off from source. So ineq. damage (or benefit) also varies.



Implications:

1. Where conc. high ^{& ineq. damage low,} dilution is no solution. Just Δs area of damage. Dilution ok when all in stage I.

2. Concentration of pollutants after the best solution.

Is used -- in garbage dumps; sewers. So opt. effluent change does not Δ with intensity, unlike auto use change, etc.

3. Redistrib. mechanism needed. Area speculation in receiving pollut. implied.

Need to add time min. Air moves, exchanges itself. Time of exposure a factor.

Dilution doesn't help if Δ s time of exposure. I.e. double area of city, but double the time that pollutants take to ~~leave~~ traverse it.

Smoke moves out in cone of dispersion. Design measures to help in stage I & II parts of cone.

Other spatial aspects.

- Dilution adds to xptn. & xptn. adds to polln.

- Segregation a basic control msre. (Air in wrong place)

Vertical - stacks

Lateral - removal of combustion from people.

" " garbage " "

Here, solution is social - higher intensity, combat sprawl.

- Problem of self-defeating conservationist, fights ~~intensive~~ polln. whenever it appears. People need a place to go to bathroom.

- Problem of intermediate densities. Re w.t. polln. Exurban problems. Again, because assuming mediums are happy.

- Ownership of space, or air in space.

Suggested approach - ripn. type doctrine.

Alternative feral naturae.

Recommended latter.

Ripn. doctrine based on myth, like geocentric theory.

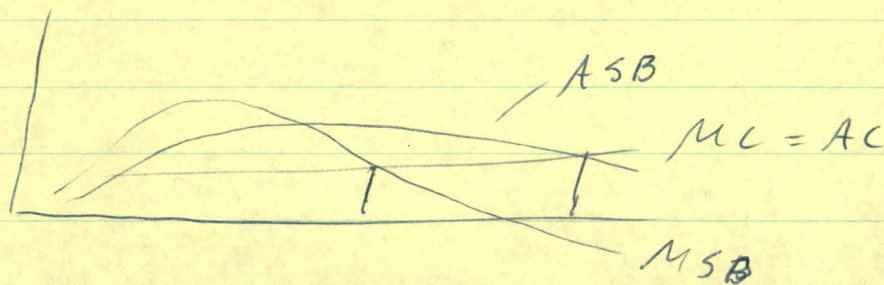
Anyway, add a space dimension to all analysis.

6. Ecs. of open access: need for control.

This concerns congestion-pollution.

E.g. pleasure boaters who get in each other's way, spoil environment.

Open access, same argu. equit. reached is ok.



Growing support for user charges. Not broad based, but selective, where $MSC > MSB$.

Concl. We are clearly headed toward more & more control of open access, dumps.

Is my belief you can make greatest ult. contrib. by giving good tech. advice to public bodies. To give it, you must have it. So go ahead, make money. But don't forget to give info. to public. And some day, reach moment of truth when it's Self vs. the public, remember in ideas.

So much for the research proposal. I also appreciate your sending me "Some Economic Aspects of Air Pollution Control". I am both delighted and disappointed with it. You are doing an excellent job of cutting down the irrational enthusiasts of pollution control, but in your efforts to balance the interests of emitters and receptors I think you are leaning over much too far in favor of emitters.

1. Suppose that A takes pleasure in Annoying B. His pleasure, indeed, comes precisely and specifically from B's annoyance. Would you conclude that A's right to annoy B is just as great as B's right not to be annoyed by A? I presume not. But this is not a fanciful case. Kids who cut mufflers and squeak tires are pretty clearly engaged in something like that. The principle is no different if we say that their pleasure comes not from annoying B, but attracting his attention.

2. Since there is a lag and a cost in enforcement, it always is going to lag behind the offenses. Thus, polluters get way ahead of receptors before the law ponderously swings into action and does something about it. By that time, community sensibilities have been deadened, the sensory perception and esthetic feelings of once sensitive beings brutalized by custom, and individual tastes have been biased for pollution by the preexistence of a non-optimal situation.

3. Every time there is non-enforcement -- and there will always be some -- there is a bias for polluters. They are the ones who commit the act. So enforcement needs to counterbalance the effects of nonenforcement.

4. The polluter is trespassing on his neighbor's property. His receptor neighbor is not equally trespassing on him by objecting to pollution. He still allows the polluter to pollute the space above his own land, just so he controls the emission so it doesn't trespass.

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DEPARTMENT OF ECONOMICS
LOS ANGELES, CALIFORNIA 90024

5. The polluter is trespassing on public property, that is the streets and parks, which comprise 25% of urban space.

6. If you pay people not to pollute, what is the base from which you start? Why should a phosphate company be paid any more than I am? How much shall I be paid to deprive me of the pleasure of renting a vacant lot and burning old tires, which I would be glad to threaten to do if I could get paid for not doing it.

7. Victims ("receptors") frequently cannot identify their assailants ("emitters".) You are perhaps overgeneralizing from the phosphate situation. In L.A., most of the assailants are automobile exhausts, in motion, and in very large numbers. It is not the rich corporation, but the little guy who controls politics, or at least has the votes, who is doing it. He is frustrated for want of a devil, but no matter. One must control a whole lot of little guys. Buying and bargaining for rights is out of the question -- autos operate on the public domain. The state must control them.

In terms of clarity of exposition, the article is very mixed. It moves from very clear to turgid. It takes a very careful reading at the end to figure out just where, if anywhere, you stand, and on what issues. I suppose this reflects uncertainty on your own part. But if that is indeed the case, then you probably should delay publishing until you have reached some more certain conclusions. But at least you have smitten the irrational conservationists and given them something to think about.

Yesterday I climbed Old Baldy, and find it a little hard to move today. But it was worth it. Friday I saw The Comedians -- don't miss it, if you can stand movies at all.

And so, back to work. Thanks again for attending to my interests with CIC.

Best regards,

Mare

SUMMARY AND OUTLOOK

- * Field burning in the production of grass seed and cereal grain crops is a highly effective agricultural practice to accomplish residue disposal, field sanitation, seedbed preparation, and yield maintenance.
- * Field burning involves major side effects in the form of air pollution. Like pollution generally, these side effects are passed on to others-- in this instance, in the form of visibility loss, soiling and other damage to property, and a possible factor in harm to health.
- * The field-burning practice is currently used in the Willamette Valley with an estimated 140,000 acres of perennial grass seed crops, 90,000 acres of annual ryegrass, and 85,000 acres of small grain crops. An estimated 700,000 tons of material is burned annually.
- * From the standpoint of benefits to agriculture, the field sanitation provided to certain perennial grass seed crops is of prime importance. There are, at present, no satisfactory alternative control measures for certain diseases of these perennial crops. No chemical control alternatives have been developed or appear likely to be available in the next several years.
- * Based on preliminary research results and observations, reductions in open field burning with certain perennial species to less than an annual basis, without major problems in productive effectiveness, may be possible. Such practices as "field flaming," a relatively smoke-free method, offer promise in replacing at least part of the open burning in perennials. Increase in disease incidence is the main concern. Higher production costs would be involved.
- * Field burning associated with annual crops--annual ryegrass and cereal grains--is beneficial from an agricultural standpoint primarily as a management practice which contributes to lower production costs. Disease control is not the important consideration that it is with perennials. However, certain annual ryegrass varieties are vulnerable to disease now controlled through field burning. Also, there are currently no suitable weed control herbicides for this crop. These annual crops represent an estimated 55 percent of the Willamette Valley field-burning acreage and two-thirds of the tonnage of residue burned. With these crops, the main issue is one of removing large tonnages of residue economically.
- * Research to date indicates that straw removal in some form is critical with both perennial and annual crops. With perennials, it appears essential in effective production of all species. With annuals, the most feasible removal alternatives to field burning are soil incorporation and mechanical removal. Large residue tonnages and heavy, wet-type soils pose problems with incorporation. It is important that a use be found for mechanically removed material. Otherwise it becomes a "solid waste" pollutant. Thus, straw utilization methods must be explored.

- * The most immediately available and promising utilization method with these crop residues would appear to be as a feed for livestock. Supplementation and pelleting are required. The use of pesticides may pose a future problem in utilization as livestock feed. At present, pesticides would be of concern with only a portion of the perennial crops.
- * Utilization of straw for industrial purposes is also feasible, but appears less immediately promising than as a livestock feed. Straw can be used in producing pulp for paper, but technical and economic problems are involved. Essentially the same kinds of problems are encountered with other industrial utilization in competition with other available cellulose materials.
- * Extensive research is under way on alternative crops for the heavy, wet type of soils now in grass seed production in the mid-Willamette Valley. Drainage, soil amendments, and irrigation will permit the production of higher value crops. Irrigation developments currently planned will have an impact in fostering a shift to other crops. A major development is the water source to irrigate a projected 160,000 acres, starting in 1976, from the nuclear power program at Eugene.

THE PRACTICE OF FIELD BURNING

This report summarizes available information on agricultural field burning in the Willamette Valley. Such information should be useful to all concerned with this practice and with the contribution it makes to air pollution in the state. The areas covered include background and basis for field burning; acreages, volumes, and emissions involved; programs underway at Oregon State University; and an assessment of certain alternatives to field burning.

At present, field burning (post-harvest burning of straw and stubble) is practiced with both perennial and annual grass seed crops and with a portion of the small grain cereal crops. The volume of smoke emissions during the late summer and fall when the now substantial acreages of these residues are burned has become a significant public issue.

This report is intended only to summarize relevant information and provide an outlook. No policy recommendations are made. The fact that the basis for and benefits of field burning from an agricultural standpoint are indicated, for example, should not be construed to mean that a continuation of this practice is thus recommended or not recommended in this report. This decision must be made through the political process--through group action with participation by all interests. The benefits of field burning as an agricultural practice must be weighed against harmful effects or "costs" in air pollution. It is hoped that the information provided will assist in this social decision.

Historical Background and Basis for Field Burning

Field burning as a cultural practice in the production of grass seed crops in Oregon dates from the mid 1940's. The practice was recommended at that time as a field sanitation measure for the control of the blind-seed disease fungus (*Gloeotinia temulenta*) which was then infecting some 90 percent of the perennial ryegrass crop in western Oregon. Since then, nearly all fields producing perennial ryegrass have been burned following harvest. These burns have effectively destroyed the inoculum of the blind-seed disease, thus providing excellent control. At the time the practice was initiated, perennial ryegrass production in western Oregon totaled some 50,000 acres, all in the mid-Willamette Valley. As other crops have been added to the list of those on which post-harvest burning is practiced, more than 300,000 acres are now involved annually.

Post-harvest burning of straw and stubble is important for the control of other diseases of perennial grass seed crops. The most significant are ergot and grass-seed nematode. Climatic conditions in western Oregon are favorable for the development of the ergot fungus. Most perennial grasses, including perennial ryegrass, are susceptible to this disease and heavy infections would result without adequate control programs. At the present time, field burning is the only effective method available for ergot control.

Grass-seed nematode, of importance with the fine-leaved fescues and the bentgrasses, is also controlled through post-harvest burning. At present, it is the only known method of satisfactory control in established fields.

The heat produced through burning straw and stubble following harvest is effective in providing at least partial control of a number of other grass diseases or disorders. Among these are the disorder, silver top, and a portion of the 125 grass rusts, 140 grass smuts, and 400 leaf and stem diseases of grasses, a number of which occur in Oregon. An added factor in disease control is that through residue removal, disease inoculum is reduced and a better base is provided for application and action of fungicides.

In addition to disease control, other important benefits now recognized from field burning include 1) removing residues effectively and inexpensively--with perennials, such residues shade and otherwise cause problems if not removed and, with annuals, subsequent crops are planted without cost of plowing or other seedbed preparation; 2) destroying weeds and weed seeds and providing a clean surface for better herbicide application and activity; 3) lowering the cost of nitrogen fertilization by eliminating residues that would otherwise require nitrogen in their decomposition; and 4) maintaining yields in perennial crops as thinning is provided and the "sod-bound" effect is at least partially overcome. Other benefits sometimes cited include fire hazard reduction as a result of early burned blocks stopping the spread of accidental fires, partial control of such pests as insects and rodents, and the release of minerals to the soil.

The extent of benefits from insect and rodent control has been questioned. Entomologists note, for example, that many serious pests of grass seed crops in Oregon are root or crown feeders. Observations indicate that field burning has little effect on this type of insect--cut worms, sod web worms, and bill bug larvae, for example. Also, field burning may foster the increase of certain harmful insects by destroying exposed insect parasites and predators, insectivorous birds, and small rodents, which would have provided natural controls.

A recognized detrimental effect of field burning, in addition to air pollution, is harm to wildlife, including the destruction of habitat. An exception would be Canada geese which feed on ryegrass fields during the winter period.

Another area, apart from air pollution, in which the benefits vs. detrimental effects are not clear is the value of incorporation of these residues into the soil. Agronomic research generally has shown a beneficial long-term effect from "plowing under" such organic material. With perennials, incorporation is only feasible as a planting is to be abandoned. However, considerable organic matter is added to the soil throughout the life of the stand from breakdown of root material.

Incorporation can pose a problem with annual ryegrass and grain crops due to the large volumes of residue often involved. With the present heavy use of nitrogen fertilizer, straw and stubble volumes of five to six tons per acre are not uncommon in the Willamette Valley. Incorporation of volumes of this magnitude is often not feasible with present tillage methods. Some combination of mechanical removal and incorporation would be required.

Where residue volumes are lower and incorporation is feasible, particularly when the detrimental effects of air pollution are considered, the benefits of incorporation surely exceed the "costs." An even stronger case can be made where such problems as soil erosion or low water infiltration rates may be involved.

With perennial grass seed crops recommendations to producers are that the straw and stubble be burned, to provide disease control (and other benefits), as soon after harvest as possible--consistent with fire hazard conditions. Perennial grass seed is produced largely for out-of-state (including foreign) markets. Rigid quality standards, including high germination and freedom from seed-borne disease and noxious weeds, are imposed. The primary method now available to obtain these quality standards is through field burning. An effective and inexpensive method of needed residue removal and stimulation of production also have been recognized as important added benefits, but they were not the original basis for recommending the practice of field burning with perennial grass seed crops.

Fields of annual (common) ryegrass are also burned following harvest. Most of this production is in one county--Linn. While some justification for this practice from a plant disease control standpoint exists, it is not the clear cut factor that it is with perennial grasses. Certain of the newer early flowering annual varieties are vulnerable to blind-seed disease. There is also a danger of harboring disease which, in turn, could infect a perennial grass seed crop if planted later on this same land. From the standpoint of the producers, higher costs of alternative methods of residue removal, the need for more fertilizer if the material is incorporated in the soil, and weed control are other key factors which lead them to practice field burning with annual grass seed crops. The practice with much of the annual ryegrass production is to reseed with a grassland drill without plowing or other seedbed preparation.

During the past several years, an increasing number of fields in cereal (small grain) production in western Oregon have been burned to remove straw and stubble. This practice is most extensive with winter wheat. Acreages of this crop have increased markedly in western Oregon in recent years. The basis for burning of grain-crop fields is that it provides a low cost method of residue removal and contributes to weed control. Disease control through burning has not been established as an important factor with small grain crops. However, certain growers have expressed concern that such disease problems as foot-rot could become serious if continuous wheat production was practiced without field burning. In the north Willamette Valley counties, burning is fairly well restricted to fields that have been in grain and are being seeded to crimson clover and other small seeded legumes following burning (and without mechanical tillage). In the southern portion of the valley, the practice of burning grain fields is much more prevalent, with low (or no) cost of tillage, less nitrogen fertilizer required, and weed control as the principal justification.

Acreage and Residue Tonnage Involved in Field Burning

Grass seed was produced for harvest on approximately 260,000 acres in Oregon in 1968. All but about 15,000 acres of this production was in the Willamette Valley. The breakdown of this grass seed acreage by crop is as follows:

<u>Crop</u>	<u>Acreage</u>
Perennial ryegrass	42,000
Annual (common) ryegrass	90,000
Bluegrasses	36,500
Fine fescues	33,500
Tall fescue	16,000
Orchard grass	10,000
Bentgrass	32,000
Total	<u>260,000</u>

In a normal year nearly all of the fields making up the 260,000 acres in grass seed production are burned following harvest. The exceptions are certain old seedings to be plowed under and the creeping bentgrasses. Thus, excluding this acreage (assumed to be 15,000 acres) and the 15,000 acres produced outside of the Valley, an estimated 230,000 acres of grass seed fields are burned annually at present in the Willamette Valley. The heavy late summer rains prevented some fields from being burned in 1968. Others were poorly burned.

Small grains are currently produced in the Willamette Valley on some 300,000 acres. For the valley as a whole, it is estimated that, weather conditions permitting, from 25 to 30 percent of this acreage is post-harvest burned. The highest percentage of burning takes place in the mid-valley counties. The percentage of small grain residue burned in the northern valley counties is much lower, with essentially no burning on lands adjacent to the Portland metropolitan area.

The volume of straw and stubble residue remaining following harvest of grass seed and small grain crops varies from around one and a half to as much as six tons per acre, air-dry weight. Assuming that 230,000 acres of grass seed crops and 85,000 acres of cereals are burned annually in the Willamette Valley, the volume of residue burned would total some 700,000 tons. This assumes a one and a half ton per acre average residue with bentgrass, the fine fescues, and bluegrass, and two and a half tons per acre for the balance of the grass seed crops and the cereals. These estimates are conservative, particularly for annual ryegrass which has heavy straw volumes.

The largest and most concentrated grass seed production area in the Willamette Valley lies between Albany and Eugene. Over three-quarters of the annual and perennial ryegrass acreage is in this area. The soils are heavy and poorly drained, and the range of crops that can be produced on these soils is limited. Installation of drainage and application of soil amendments would be required to increase the range of crops that could be produced. Irrigation would also be required with certain alternative crops.

Emission Content and Volumes from Field Burning

Emissions into the atmosphere from the burning of straw and stubble is characteristic of vegetative plant sources generally. Cellulose and lignin are the primary constituents. Emissions consist of smoke, made up of carbon particles of varying sizes, ash, and certain gases. Most of the carbon

particles are minute in size and indistinguishable without visual aid, while others are readily visible. The former, characterized as aerosols and constituting "suspended particulates," are a major factor in reduced visibility, while the larger particles, which settle out more readily, are factors in soiling and deposits on property. The principal gases emitted are the organic hydrocarbons, carbon dioxide, carbon monoxide, and oxides of nitrogen.

On the basis of controlled burning tests, indications are that carbon particulate (larger soot particles and smaller suspended material) emissions from grass seed and cereal straw are in the 10- to 20-pound range per ton of material burned. Assuming an average figure of 15 pounds per ton with 700,000 tons burned, the total particulate material released into the ambient air of the Willamette Valley each year from field burning would total 5,250 tons. This does not include ash particles, including those remaining on the ground following burning, which may later be picked up by the wind to become air borne.

Tests by the University of California Air Pollution Research Laboratory at Riverside have shown that the level of total hydrocarbons (organic gases) in emissions from straw burning is in the same range as particulates--around 15 pounds per ton. These levels of particulates and hydrocarbons are based on favorable conditions both with the straw and the weather. Higher moisture content of the straw, presence of green regrowth, and weather conditions that would lower combustion efficiency would increase both particulate and hydrocarbon levels.

Carbon monoxide levels in the California tests ranged from 80 to 120 pounds per ton of residue burned. Analysis for oxides of nitrogen were limited in these tests and did not permit expressing results in pounds per ton of waste burned. Concentrations during burnings, however, were reported as ranging from 21 to 42 parts per million.

Harmful Effects of Field Burning

Certain harmful effects of field burning are obvious and clearly defined. These include such effects as loss of visibility and soiling and other damage to property. Other effects, such as possible harm to human health, are not clearly established. However, because of recent public statements and press releases on the subject of possible health effects from smoke emissions from burning agricultural and forestry residues, such as straw and slash, some background on the subject appears important. It must be stressed that there has been no research at Oregon State University on this subject. Nor are there any research results from other sources, known to the authors of this report, that relate specifically to health effects from the particulates released through burning the type of plant residues involved here.

The concern, from a health standpoint, is that it is now being recognized that smoke particulates can play a role in making other pollutants more harmful. Scientifically, this is referred to as a "synergistic" effect. The combined effect from two or more pollutants exceeds the total of their individual effects. The carbon particulates in the smoke, it is being found,

both adsorb and absorb gases and mists, which may be toxic. The particulates, it is believed, can then carry these toxic pollutants deeper into the lungs and hold them longer. Sulfur oxides, nitrogen oxides, and certain of the hydrocarbons are the air pollution gases with toxic properties that are present in most urban environments.

Particulates from field burning sources, during the fall period when this burning is under way, add to the particulates from other sources to provide the smoke ingredient for this possible combined (synergistic) effect. These other sources include furnaces, fireplaces, and stoves; backyard burning; industrial and commercial activities; automobiles and other transportation devices; and forestry practices. It must be noted, however, that in areas downwind from fields being burned, this source is recognized as the major contributor during the field burning period.

There are various areas of concern regarding the contribution of smoke from field burning to visibility reduction. These include the nuisance and property value effects on Oregon residents; the impact on the tourist industry; and hazards imposed (and possible economic loss) on such activities as air and road transportation. Research is being undertaken at Oregon State University on certain aspects of this visibility reduction problem.

Research and Service Programs with Field Burning

Research has been conducted and is currently under way at Oregon State University in a number of areas relating directly and indirectly to the practice of field burning. The work concerns both reducing harm from field burning and providing a basis for alternatives leading to the reduction or elimination of field burning. Extension educational activities complement the research efforts.

Initial activities related to field burning, in addition to the work noted earlier that led to the development of the practice, began in the early 1960's on a cooperative basis between the seed industry, the University, and the United States Weather Bureau. The over-all objective of the program was smoke abatement. Areas investigated included timing of burns with weather conditions favorable to smoke dispersal and preventing concentrations of burns in the late fall.

Further efforts in research relating to field burning began in 1965 with a study by B. R. Meland and R. W. Boubel in the School of Engineering. The work was supported through a federal training grant in air pollution. Objectives of this study were "...to determine the effect of environmental variables on grass field burning and...if conditions exist when significant air pollution reduction can be achieved...." Companion studies were also initiated by the Agricultural Experiment Station under the supervision of D. O. Chilcote on agronomic effects of various burning practices and by meteorologists W. P. Lowry and R. M. Black on weather relationships. Attention centered on estimating variation on a day-to-day basis of atmospheric volume available for dispersal of pollutants.

The cooperative program between the agricultural and engineering stations was expanded in 1966 with the establishment of extensive field plots. Such factors as the effects of time and intensity of burning on smoke volumes and crop production were studied. Both time of day and season of the year

when fields were burned were related to smoke emissions and dispersion and subsequent seed yields. The agronomic phases of the work were fostered through a \$10,000 grant from the seed industry.

Also, in 1966, J. R. Hardison, USDA Plant Pathologist, expanded his research on methods of eradication of seed infections. Federal and seed industry funds totaling \$6,500 provided through the State Department of Agriculture helped support Dr. Hardison's work.

With the new biennium starting July 1, 1967, added funds for field burning research were provided from the Oregon Legislature. The initial appropriation was for \$102,153 for the two-year period. However, this was subsequently reduced through a cutback in state support resulting from defeat of the tax measure, so the final biennial total of new funds was \$67,040. Funds in the current biennium have been supplemented through a research grant from the federal air pollution agency for the School of Engineering phase of the cooperative program.

In the current year, in addition to the research under way on reducing harmful effects, a start has been made in research on straw utilization.

A number of projects are under way in the Agricultural Experiment Station, and elsewhere in the University, that contribute information pertinent to the field burning problem. Particularly relevant is work in feeding livestock on pelleted straw rations, chemical and microbiological processes for breakdown of cellulose containing solid waste products (like straw), and testing alternative crops and production practices on the heavy soils now producing grass seed crops.

A service program in meteorological forecasting has been maintained during the past two years to provide a basis for the issuance of permits to burn. The Weather Bureau Office for Agriculture, located at Oregon State University on a cooperative basis with the Agricultural Experiment Station, has handled this service. In earlier years, the service was provided to growers on an "advisory" basis.

There is concern on the part of both the Weather Office and cooperating University personnel that this pattern has not proved to be fully effective. Certain burning has been done during periods of adverse meteorological conditions, contrary to the forecast advice. The problem of exceeding the capacity of the atmosphere of the basin to dilute and/or disperse smoke from concentrated burning under fair or even good meteorological conditions also exists. How much the unfavorable weather during this period was responsible for these shortcomings or how much they are inherent problems that will always exist under this type of program is difficult to assess.

Consideration of Alternatives to Field Burning

Up to this point attention has been devoted to the background of the practice of field burning and to relevant research at Oregon State University. In the remaining sections, consideration will be given to various alternatives

to reduce the harmful side effects of field burning or contribute to the elimination of at least a certain part of the burning.

Alternatives in the area of the alleviation of harm from field burning fall broadly into two categories. One alternative is to find ways to reduce the harmful effects of field burning. The other broad alternative is to find ways that will lead to a reduction of the acreage burned.

Included under the broad alternative of reducing harmful effects would be such approaches as timing the burns to coincide with the best meteorological conditions for smoke dispersal and with optimum condition of the residue for highest combustion efficiency and lowest emission levels. With meteorological conditions, it has been found that both time of the day and season of the year are significant. In relation to the condition of the residue, early season burning before regrowth of green material and dryness of the material are important factors in both emission volume and composition. Another possibility is to remove a portion of the residue (such as all of the straw, but not the stubble) to decrease emissions, but still employ open burning. The question here is whether sufficient heat would be produced to control crop diseases.

Possibilities or approaches under the alternative of reducing acreages burned include the following:

- 1) Establishing a basis for restricting field burning to certain species or types of crops, excluding field burning from certain geographic areas, and/or limiting the frequency of burning (less frequent than an every year basis with certain perennials, for example).
- 2) Removing the residue from annual crops and employing such tillage, weed control chemicals, or other practices as may be required in the production of a subsequent crop.
- 3) Removing the residue from perennial grass seed crops and employing such practices as controlled "field flaming," using a fuel such as propane; chemical disease control if and when effective chemicals are available; supplementary weed control measures through chemical means; cultural, or other measures to maintain vigorous and productive stands.
- 4) Shifting to crops that do not depend on field burning in their production.

In certain of the alternatives considered above, removal of part or all of the residue would be involved. Thus, disposal of this material in ways other than through combustion in the field would be required. If the material could be put to a valuable use, with a monetary return to the producers, an added incentive would be provided. A number of approaches exist for such utilization. Those which appear to offer possibilities, considering the great volumes of material involved, include the following:

- 1) A source of livestock feed.
- 2) Raw material for production of pulp for paper making.

- 3) Other chemurgic utilization, such as furfural for plastics production.
- 4) Manufacture of charcoal and activated carbon.

The balance of this report is devoted to individual statements by various staff specialists at Oregon State University on certain of the alternatives covered above, as well as other pertinent research findings. These statements are intended to provide information useful in appraising the merits of the various alternatives. They are not intended to in any way constitute a recommendation. The statements provide both an "outlook" on the alternatives being considered and a summary of research findings that are relevant. The final statement provides a summary of emission data from grass field burning tests.

Seminar Schedule
Fall Quarter, 1969

ECONOMIC EFFECTS OF AIR POLLUTION

1. Benefits of Burning

October 2 Thursday	9:30 a.m.	David O. Chilcote, Assistant Professor Crop Physiology Oregon State University
October 9 Thursday	9:30 a.m.	George R. Fahnestock, Research Forester Pacific Northwest Forest Experiment Station

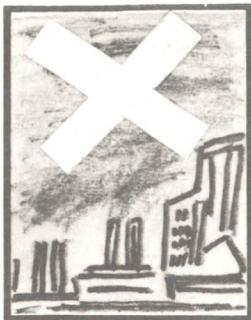
2. Problems in Specifying a Benefit-Cost Framework

October 16 Thursday	9:30 a.m.	Wm. Craig Stubblebine, Associate Professor of Economics Claremont Men's College
October 23 Thursday	9:30 a.m.	Colin Wright, Assistant Professor of Economics Northwestern University

3. Problems of Cost Measurement and Alternative Control Methods

October 31 Friday	3:30 p.m.	William Vickrey, Professor of Economics Columbia University
November 6 Thursday	9:30 a.m.	R. Charles Vars, Jr., Assistant Professor of Economics Oregon State University
November 13 Thursday	9:30 a.m.	Gary W. Sorenson, Assistant Professor of Economics Oregon State University
November 20 Thursday	9:30 a.m.	Mason Gaffney, Professor of Economics University of Wisconsin-Milwaukee
December 4 Thursday	9:30 a.m.	William C. Brainard, Professor of Economics Yale University

All meetings will be held in the Board Room of the Memorial Union.



Air Pollution Notes

COOPERATIVE EXTENSION SERVICE

NEWSLETTER

Published as part of the environmental sciences program, College of Agriculture and Environmental Science, Rutgers University - The State University of New Jersey, New Brunswick, N.J. 08903 and the U.S. Department of Agriculture cooperating. Franklin B. Flower, editor

Vol. III #5

Aug. - Sept. 1969

CLEANER AIR WEEK - The Twenty-First Cleaner Air Week will be held Oct. 19-25. This program is sponsored by the National Air Pollution Control Association. It is the purpose of this week to:

- 1) Create better understanding of community, state, and local problems related to the protection of our fresh air supply.
- 2) Promote cooperative effort toward the solution of such problems.
- 3) Encourage individuals and groups to coordinate control efforts particularly at the community level.

If you wish help and guidance in your community Cleaner Air Week program, write to Joseph J. Soporowski, Department of Environmental Sciences, Rutgers College of Agriculture and Environmental Science, New Brunswick - 08903.

MEETINGS OF INTEREST

AIR POLLUTION AND RESPIRATORY DISEASE SYMPOSIUM - "Where We Are in Research and Where We Are Going in Control" is the title of the Fifth Annual Symposium on Air Pollution and Respiratory Disease. This symposium, co-sponsored by New York University Medical Center, the Bristol Laboratories, and the Queensboro Tuberculosis and Health Association, will be held Oct. 23 at the New York University Medical Center, 550 Fifth Ave., New York.

The morning session will be devoted to "Health Effects of Air Pollution - an Assessment of Current Research." The afternoon session will discuss "Long Range Approaches to Environmental Improvement." C. C. Johnson, Jr., Administration of Consumer Protection and Environmental Health Service, USDEW, will present "Environmental Improvement - a View Into the Future."

Registration and luncheon are free for those who register in advance. For additional information communicate with Kenneth Kowald, New York Action for Clean Air Committee, 105 East 22nd St. New York, 10010.

AIR POLLUTION EMERGENCIES: CAUSES, CONTROLS & CONSEQUENCES will be the theme of an all-day technical conference, Oct. 17, in the auditorium of the Public Service Electric & Gas Company, 70 Park Place, Newark, N. J. The morning session of the Mid-Atlantic States Section of the Air Pollution Control Association, the National Technical Society in the

field, will open with a discussion of the "Effects of an Air Pollution Emergency on Community Health" by Stephen A. Ayres, M.D. of St. Vincent's Hospital and Medical Center, Manhattan. Dr. Frank Field, science editor for WNBC-TV, will discuss "The Role of Communications Media in Air Pollution Emergencies." Representatives of the electrical and chemical industries and all the major air pollution control agencies of the Mid-Atlantic states will participate in discussing aspects of air pollution emergencies.

APCA TO PUBLISH AIR POLLUTION EXPERIMENTS MANUAL - Publication of an initial 25,000 copies of "Air Pollution Experiments for Junior and Senior High School Classes" is under way. The manual was prepared by the education committee of the Mid-Atlantic States Section of APCA. It is expected that these manuals will be sold for a minimal fee. Details of the manual will be announced in a later issue of "Air Pollution Notes."

FUTURE SHORT COURSES - The U. S. Public Health Service in cooperation with the Rutgers College of Agriculture and Environmental Science will present the following 5-day courses at Rutgers this fall or winter:

"Urban and Environmental Health Management," designed for health officials who are responsible for the day to day operations of environmental health programs; how to program interlocked problems; basic management concepts to bring the environmental health program to a more fruitful conclusion.

"Environmental Microscopy," for chemists, engineers, sanitary technicians, and other technically-oriented individuals who are working in the field of environmental health. Analysis of particulate matter by physical methods using microscopy will be stressed. Registration limited to 24. Later on advanced microscopy course will be presented. However, only those who have completed the basic course will be eligible to take the advanced course.

N. J. BAN ON SMOKING JETS - On Aug. 12, seven airlines operating at Newark Airport were charged in Superior Court with violating Chapter 4 of the N. J. Air Pollution Control Code. Chapter 4 limits the density of smoke emissions to No. 2 on the Ringlemann Chart, except for limited specifics. Number 2 Ringlemann is equivalent to the observation of 40% of the transmitted light.

Violators of this code could be fined to \$2,500 for each day of operation in violation. However, the N. J. Department of Health is seeking to have the airlines install devices or mechanisms or make modifications in the engines to prevent such violations. It is hoped that the airlines will come forth with a reasonable time schedule for implementing the necessary steps and procedures to achieve compliance. However, the airlines didn't even show up at a late August meeting called for them by NAPCA Commissioner, John T. Middleton, to discuss similar problems on the federal level. Instead, some 24 of the U. S. airlines were represented by their trade association which indicated that a majority of engines would be smokeless by the mid-1970's. Both the federal government and the State of New Jersey are seeking an earlier reduction in smoke emissions.

CHAPTER 10A NJAPCC NOW IN EFFECT - Provisions of Chapter 10A, regulating the amount of sulfur in coal, are now binding on all N. J. users, transporters, and sellers of coal. To conform with Chapter 10A, bituminous coal can contain no more than 1% sulfur; anthracite, not more than 0.7%.

This Code finally became effective May 8 when the N. J. Supreme Court upheld the violation of Chapter 10A by the Appellate Division of Superior Court. The code provides for certain alternatives where installations use gas cleaning equipment in their stacks. The alternative is to install equipment which will remove sulfur dioxide from the flue gas before discharge to the atmosphere. Chapter 10A calls for a second step in the reduction of sulfur content of coal to take place on Oct. 1, 1971. At that time the allowable sulfur content in both bituminous anthracite coal will be reduced to 0.2%. Seven rural counties (Atlantic, Cape May, Cumberland, Hunterdon, Ocean, Sussex, Warren) are exempt from the provision of step 2.

PESTICIDE DISPOSAL - A recent issue of the "New York Sunday Times" carried an excellent article on safe methods of disposal of pesticides.

The article emphasized that in order to sufficiently incinerate these POISONS you must have a high temperature incinerator with adequate gas scrubbing systems. Both the correct and incorrect methods of disposal are discussed.

For a single copy of the informative article write to "Air Pollution Notes."

PLASTIC MANUFACTURING PLANT SHUT DOWN BY N. J. COURT - Southbridge Plastics Company, Clifton, N. J. has been shut down permanently and fined \$5,000 for violation of the N. J. air pollution control regulations. The Superior Court action, which also found the firm in contempt of an Oct. 11, 1968 court order to accomplish corrective measures, represents the second time in the history of the State's air pollution control effort that a plant has been shut down by an order of a court.

The complaints were brought against the company by 15 area witnesses who complained of odors and other effects from the plant. Southbridge Plastics employed more than 100 persons.

N. J. PROMOTES AIR POLLUTION CONTROL PERSONNEL - Herbert Wortreich, former supervisor of field control operations, has been named to the new post of chief enforcement officer. Thomas N. Leonard, former supervisor of the permits and certificate section, succeeds Wortreich as field control supervisor. James S. Moran, former assistant supervisor of the metropolitan field office in Springfield, has been named head of a newly created section responsible for assisting in the development of local air pollution control programs throughout the state. David J. Shotwell of the metropolitan field office has been named supervisor of that office. Joseph A. Rzigolinski, supervisor of the central field office in Trenton, has been promoted to supervising public health engineer as has Martin L. Sanvito of the southern field office in Pennsauken.

AIR POLLUTION EMERGENCY REGULATIONS ESTABLISHED - Chapter 12 of the N. J. Air Pollution Control Code establishing regulations for the prevention and control of air pollution emergencies will become effective Oct. 24, 1969.

Chapter 12 sets forth the criteria for determining the status of the air pollution situation; it delineates 3 critical stages of air pollution levels, along with the conditions existing at each stage. The ambient air levels of sulfur dioxide, carbon monoxide, and general dirtiness, are used to determine whether we are at the ALERT, WARNING, or EMERGENCY level. Standby plans are required for reducing emissions. The emission reduction objectives for the various air pollution levels are presented, and standby orders which might be appropriate for use by the Governor upon his declaration that an air pollution emergency exists are suggested.

The Act and code are designed to able the State to cope with the potentially dangerous situation which could result from an incident of atmospheric stagnation.

The Air Pollution Emergency Act authorizes the Governor to declare by proclamation the existence of an air pollution emergency. The Governor may then issue an executive order directing immediate reduction of air pollution from all sources specified. The order may prohibit, restrict, or condition motor vehicle traffic, the operation of retail, commercial, manufacturing, and other industrial activities, the use of incinerators, combustion of fuels, the burning of materials, and other activity which contributes atmospheric pollution. The law provides for a maximum of \$100,000 fine and 10 years in prison for violation of a Governor's order.

AIR POLLUTION INJURY TO VEGETATION 1969 - Professors Eileen Brennan and Ida Leone report that they have observed the following air pollution injury:

March - Ozone fleck on tobacco in a New Brunswick greenhouse.

April 25-29 - Typical ozone damage to spinach in Vineland. High ozone levels were noted at the New Brunswick air sampling station at this time.

May 9 - Petunias severely damaged in a North Plainfield greenhouse by oxidant. Value of flowers damaged was about \$100. Probably not a total loss as most may recover.

May 16 - Chlorine leak at a sewage treatment plant in Yardville injured many plant species (rose, violet, honeysuckle, azalea, hydrangea, privet, phlox, blue spruce.)

June 30 - Injury to chrysanthemums, snapdragons, and carrots on Staten Island. Possibly due to sulfur dioxide that may have originated in New Jersey.

For additional information about any of the injuries communicate with Professors Brennan and Leone, Department of Plant Biology, Rutgers CAES, New Brunswick, 08903.

'VISUAL EMISSIONS EVALUATION' SHORT COURSE AT RUTGERS - This 6-day short course will be presented on the Rutgers CAES campus in New Brunswick. Classroom sessions will be conducted Oct. 27, 28, and 29; field work, Oct. 30, Nov. 3 and 5. However, due to the nature of the course it is not possible to have more than 20 students participating at one time during the last 2 field days. Therefore, if more than 20 students register for the course, additional field training days will be held in November.

In addition to teaching the students how to evaluate the density of both black and white smoke in terms of the Ringlemann Scale and equivalent opacity, the program is designed to give governmental air pollution control officials, such as sanitarians and air pollution inspectors, a general understanding of the overall air pollution problems.

Emphasis will be placed on pollution derived from combustion processes. Governmental employees who satisfactorily complete all requirements (attendance, classroom and field examinations, and homework assignments) will be awarded a certificate by the N. J. State Department of Health certifying that they have been trained to read the densities of visual emissions. Those who wish to take only the first 3 days of the course, which are devoted to describing the fundamentals of air pollution, may do so at a reduced registration fee.

For additional information about these short courses communicate with Franklin B. Flower, Dept. of Environmental Sciences, Rutgers - CAES, New Brunswick, N. J. 08903.

Very truly yours,



Franklin B. Flower
Associate Extension Specialist
in Environmental Sciences

*Positive, immediate and creative
citizen action is needed, NOW*

Is Pure Air a Vanishing Commodity?

Pure, fresh, uncontaminated air is becoming scarce—is it a vanishing commodity?

The very breath of life upon which mankind must depend for continued existence is freighted with perils and poisons—the unhappy by-products of this technological age.

Concomitant with deteriorating atmospheric quality is a pervasive public apathy which seems to accept the miserable adjunct of civilization, polluted air, as a necessary evil. Evil it is, but is it necessary?

How can such dull unconcern exist in an apparently enlightened age? As our air diminishes in quality, so does the quality of life. Does our inability to see clearly in defiled air affect our ability to think clearly as well?

Articulate ecologists warn mankind of accelerating dangers of pollution, using words anyone can understand—yet, Mr. Average Citizen is apt to turn the television or radio to another and more entertaining program, or the page to more pleasant reading. But ignoring air pollution will not make it go away. Positive, immediate and creative citizen action is needed—NOW.

Pollution of our planet is proceeding at an unprecedented scale which must be arrested for the sake of all life, including man, states Dr. Stephen Collins. The committee on atmospheric sciences of the National Academy of Sciences estimates that "we have, at best, one or two generations" in which to acquire an understanding of the pollution problem and to find effective solutions. There are some scientists, more pessimistic, who

state that our great-grandchildren may well be the last humans on earth if something isn't done.

Concerned citizens are increasingly disturbed over dingy air and all it portends. To alert the more casual citizen, it may be essential to quote and requote the shocking statistics such as those of the Donora, Pennsylvania, catastrophe when hundreds of persons became ill and 20 died during a brief period when that narrow mountain valley was drenched in a poisonous smog which was locked in by an air mass above.

In London there was a dreadful period of death and destruction in 1952 when 4,000 deaths occurred over a five-day period, all attributed to the stagnant, stabilized smog which blanketed the city.

Buenos Aires, contrary to its name, is suffering from soiled air. So is Tokyo, Taipeh, and every other major city of the world where there are automobiles in large numbers or industrial plants which spew out harmful pollutants. The United States, which has the most motorcars, also has the most smog.

Los Angeles is a synonym for smog in the minds of many persons for it was there that scientists first pointed to the photochemical reaction of sunlight with the deadly hydrocarbons of automobile emissions as the catalyst in the creation of PAN (Peroxyacetyl nitrates). Years of exacting PAN research at the University of California Air Pollution Center in Riverside, and elsewhere, documents the devastation of PAN on plant life. It is not as sim-

(Continued next page)

ple to pin down the damage to the human organism, for you don't put a man in a test-tube situation and saturate him with smog to see how long it takes him to die.

Man, however, subjects himself to smog because that is where he lives, works, breathes. Why does he endure this degradation of the vital breath of life? What choice has he unless he is independently wealthy and can run away to mountaintops or go on ocean voyages—and anyway, if present trends continue, there may soon be no escape from this poor air anywhere on the planet Earth.

"In the old days, only the poorest people lived on the wrong side of the railroad tracks where they had to endure soot and smoke. Today, we all live on the wrong side of the tracks" says Robert O. Low, New York City councilman and air pollution expert.

Most air pollution results from the infusing into the air of waste products of the activities of man, and in the United States, the automobile is cited as the chief contributor to air-pollution problems. This is because of the discharge of raw hydrocarbons into the atmosphere resulting from the incomplete combustion of the gasoline engine. According to a recent Senate report, automobiles account for about 85% of the air pollution in the big urban areas and 90% of all the carbon monoxide pollution. In all, automobiles exhaust more than 90 million tons of pollutants into the air each year—twice as much as any other fouler of the atmosphere.

Millions of dollars have been spent during the past quarter of a century on "devices after the fact," designed to clean up engine exhaust before it escapes. Most of these controls, expensive and complex or simple and less costly, have so far failed to accomplish more than minimal success. Air-pollution agencies, from the top down, have established all sorts of criteria, controls and sampling procedures for reporting the quality of

the air. There is a pyramid of officials charged with the responsibility of safeguarding the air we breathe. For the most part, their efforts are directed to trying to capture and render harmless the escaping poisons from the millions of automobiles. In spite of strict controls, however, Los Angeles, for example, has about the same amount of smog now as it had a decade ago, according to **Technical Weekly Science**. The problem is, new sources of pollution have kept pace with efforts to curb old ones.

By the 1971-model year, all new cars will be equipped with controls ordered by standards of the Department of Health, Education, and Welfare. The 1970-model cars sold in California will have these controls. They call for (in addition to present controls for exhaust and crankcase emissions) controls on evaporative emissions from the fuel tank and carburetor and for reductions of 80% in hydrocarbon and 70% in carbon-monoxide emissions compared with the 1961-model year. The Detroit auto makers claim that they have won the battle against automotive air pollution. Certainly, not everyone shares their optimism, however. Even if their new "devices" are successful, it will be several years before they will noticeably lessen the smog level, because the present cars, not having the devices, will still be operating for up to at least another ten years.

Perhaps some new and original thinking is called for. One man, an Inglewood, California scientist, has a different approach which he states could greatly lessen smog within a few weeks. This man is L. Mills Beam, chemist and man of many talents, president of the W-6 Company. W-6 is a gold-colored liquid to be added to gasoline or other petroleum fuels. According to Beam, W-6 is a catalytic vegetable compound which may be added to any of the fossil fuels—gasoline, kerosene, diesel or jet fuels. He explained that its catalytic action alters the molecular struc-

ture of the fuel in a manner so that the molecules become more available to the oxygen number—an essential condition for complete fuel combustion. More complete combustion of fuel would mean that the petroleum emissions problem would be solved at the source rather than at the end after combustion which is the approach when so-called smog devices are employed.

This is good theory, but does it work? We found our answer to this question in the reports from independent laboratories. The Hornkohl Laboratories, Inc., Bakersfield, California, conducted tests using 10 cars and one motorcycle, all of them having extensive mileage on them. During the testing period, each of the vehicles was run over 3,000 miles under many types of running conditions. Each was tested at 300-mile intervals, with and without the W-6 additive. Carbon monoxide was reduced to an "unbelievable" degree, according to Dr. Heinz Pickel, head of the laboratories. Without the use of W-6, the average carbon monoxide content of the exhaust was 3.7%. With the use of the additive, the level was reduced to an average of 0.9%. Also noted was a substantial fuel mileage increase.

Running what is called an "instant" test, the Truesdale Laboratories, Inc., Los Angeles, another independent and impartial testing facility, noted that W-6 showed an 86 per cent reduction in carbon monoxide.

Motorists who find themselves packed in stop-and-go traffic for miles upon miles may become irritable and annoyed at the inconvenience and delay, but more serious, their exposure to carbon monoxide from idling and accelerating engines may seriously impair judgment at a time when mental and visual acuity are critical. Some believe that many cases of deaths in stalled traffic situations result from the carbon monoxide concentration affecting susceptible individuals.

W-6 has the seal of approval of the Government of Mexico where the product is readily available and where its use is steadily increasing. In this country, where testing has been going on for the past seven years, there are substantiating reports from police departments, trucking firms, bus lines, taxicab companies, and individual citizens. These letters report a reduction in noxious exhaust emissions, increased fuel mileage and improved engine performance.

At this point, it should be made clear that in giving this report, the National Health Federation is not endorsing W-6 or any other product—NHF policy would not permit this, anyway. Our only interest is ridding our atmosphere of suffocating smog. Any idea, product or device which may offer any aid whatsoever in achieving this end deserves our attention.

Naturally, to be effective in bringing about any significant reduction in smog, any product of this sort would have to be added to all gasolines and diesel fuels. This is the goal of Dr. Beam's efforts. He has steadfastly refused to release W-6 on an exclusive basis to a single oil company or to any other vested interests where it might be "pigeon-holed" and kept from the general public.

Some of the enthusiastic boosters of the product, W-6, have suggested that we can hasten the day when we can again have clean air and clear skies if we were all to write our own oil company asking them if they have investigated W-6 and when they are going to add it to their gasoline.

The time has come when the problem of air pollution must be viewed as a life-or-death matter. There is only a limited amount of time left in which solutions to the problem must be found if life on this planet is to endure.

A recent Gallup Poll sampled the public's attitudes towards its natural
(Continued next page)

surroundings. More than half said that they were "deeply concerned" about the threats to our environment from air and water pollution, erosion and wildlife destruction. Another 35% were "somewhat concerned." There is both hope and comfort in this growing public concern because really effective programs to combat the pollution of our environment will come only in response to public concern . . . and pressure.

In the process of finding solutions to some of our pollution problems, it undoubtedly will be necessary to step on economic toes and the cries of pain will be loudly heard. Far too often has corporate profit been held to be more important than the welfare and the future of mankind. For this reason, it is necessary that the average citizen urge his legislators on both state and national levels to initiate or support anti-pollution measures.

My Country

I love Michigan.
It's cold and severe,
But, because I was born there,
I still hold it dear.

I love California,
The state that I chose,
For its climate and beauty,
Where the Giant Redwood grows.

I love my country,
The red, white and blue.

It has its faults,
More than a few.

But where could I go
Where a country would be
As generous with freedoms
As it's been to me?

My ancestors were born here,
Long before me.
So this is my country,
And always will be.

—Mary H. Manwaring.

POLLUTION NOTES: Emphysema, the disease traced to smoking and air pollution, now disables more Americans than any other cause except heart disease—and emphysema cases are skyrocketing. . . .

When oil sludge foam was dumped into the Alleghany River in Pennsylvania recently, a 12-mile-long slug of pollution formed, and it held together all the way to the Mississippi. More than a million fish were killed. (The District Line, Washington **Post**, 1-6-69)

Garbage and pollution is a vicious-circle problem fast becoming a sphere of crisis for cities. Burning trash and garbage creates most of the pollution being pushed into the air at the rate of 142 million tons per year, and the problem is world-wide. London spends \$48 million a year on waste disposal, and Belgium's open-air garbage dumps have more rats than Belgium has people. Solutions still in the planning stages in various U.S. cities are to ship refuse by rail for disposal outside cities, dump it in abandoned hard-coal mines, disinfect sewage sludge with atomic radiation. (Washington **Examiner**, 12-19-68)

The first suit filed under the Federal Clean Air Act has ended with the Bishop Processing Co. of Bishop, Md. agreeing to stop polluting the air.

March 7, 1968, the Department of Justice charged Bishop, an animal-rendering plant, with discharging malodorous pollutants into the air near the Delaware state line. On November 1, a consent judgment, directing the company to stop discharging those pollutants, was signed. The judgment went into effect immediately, but did not specify how to stop the spread of pollutants. The judgment also provided the Delaware director of air pollution with the authority to declare such pollutants from Bishop, reaching into his state, to be unlawful. When this happens, a court order may be issued to close the processing plant immediately. (Washington **Post**, 11-5-68)

COUPLE AWARDED DAMAGES IN PLANT FUMES LAWSUIT

A federal court jury awarded a Springfield, Ore. couple \$2,147 in compensatory damages after U. S. Dist. Judge Robert C. Belloni directed a verdict against the Weyenhaeuser Timber Co.

Mr. and Mrs. William Carey said odors and fallout from the company's pulp mill near their home damaged the paint on their car, truck and home.

Carey charged the odors caused throat and eye irritation and his doctor testified that if he continued to breathe the odors it would reduce his life expectancy by five to 10 years.

The jury awarded no punitive damages and made no ruling on Carey's complaints of health damage.

The Careys, in a joint suit and a single suit by the husband, had asked \$170,000 altogether.

Belloni ruled against the company but said damages awarded could be as low as 6 cents. The judge said the trial established a "definite trespass against the Careys by the pollution of the Weyerhaeuser craft mill."

DEADLY PARATHION SPILLS OVER TRAIL

Collier County, Florida deputies and the Florida Highway Patrol recently guarded two spots on the Tamiami Trail where a deadly agricultural poison, parathion, had spilled from an unknown truck.

Health Department Sanitarian Bennie Jones said he was making a search for a supply of caustic soda, a chemical used to neutralize the organic phosphate which is sprayed ordinarily from airplanes over farm crop fields.

The material spilled along the Trail east of Naples and near the intersection of the Trail with S. R. 92 at Royal Palm Hammock is 1½ per cent parathion in sulfur, Jones said.

He warned it is poisonous to human

beings and can be absorbed through the skin.

Soon after the spillage was reported, the health department ordered loads of dirt spread over the powdered chemical to prevent its flowing through the yards of nearby residents, motels and businesses, Jones said.

The sanitarians said flushing the poison away with water was rejected because drainage ditches would carry the chemical into the same potentially hazardous areas.

Jones said the Dade County Pest Control Office recommended using caustic soda to neutralize the parathion, but "our efforts the first couple of hours at least did not turn up any supply of the soda."

CALIFORNIA'S PELICAN POPULATION FACES EXTINCTION BECAUSE OF DDT

Poisoned by a widely used agricultural insecticide, California pelicans are laying eggs that contain the seeds of their own destruction, a marine biologist said.

The ungainly, big-beaked birds—now nesting at several off-shore islands, face extinction because of concentrations of DDT which have seeped into their ocean feeding grounds.

Dr. Robert W. Risebrough, a scientist with the University of California's Institute of Marine Resources, said the pelicans are laying eggs with shells so thin they crack apart under the weight of the mother.

Measurements indicate the shells are about half the thickness of eggs examined 30 years ago.

Risebrough said he and others have examined traditional nesting grounds from the Channel Islands off Oxnard, to the Coronados and San Martin Islands off the coast of Mexico.

During a trip to Anacapa Island, Risebrough said, he and representatives of the U. S. Fish and Wildlife Service counted 298 new nests. Only 12 contained intact eggs and the remainder were littered with pieces of flaky, brok-

SCANNING THE NEWS . . .

en eggshell.

The scientist said laboratory examination of the broken eggs indicate the shells are extremely deficient in calcium so they crack almost as soon as they are exposed. In addition, the laboratory analysis showed heavy concentrations of DDE in the fatty part of the yolk. DDE is an altered form of DDT.

Risebrough said the insecticide enters the ocean after it is either washed off plants by rain or carried through the air as a spray. Once in the ocean, it is absorbed into plankton. Small fish, in turn, eat the plankton and are consumed by the pelicans.

At each stage, the DDT become more concentrated because it dissolves in fats.

RADIOACTIVITY IN COLUMBIA TOPS ALL WATERS

More radioactivity is found in the Columbia River than in any other known surface body of water in the world according to a recent report by the Oregon State Board of Health.

The six-year study was financed by a federal grant and state funds to evaluate the distribution of radionuclides in the Lower Columbia and the Oregon sea coast. A nuclide is a type of atom.

The study concluded that the primary source of the 10 radionuclides identified in the study is the Hanford reactors, which are cooled by Columbia River water. The highest fission product activity appeared in soft-shelled clams.

"Although the observed levels were low and no action is required at this time, continued surveillance is essential to insure that future levels and trends remain below recommended standards," the report concluded.

POLLUTION KILLS FISH STOCKED FOR CHILDREN

A thousand youngsters lined Mineral Palace Park pond in Pueblo, Colorado with cane poles but failed to hook a single fish. The Veterans of Foreign Wars stocked the lake, but all the fish died of water pollution.

SMOG SUIT ENCOMPASSES WORLDWIDE DEFENDANTS

An attorney has launched his own attack against smog by filing a \$500-billion suit against virtually everyone and everything in and out of Los Angeles County capable of producing air pollutants.

Roger J. Diamond, 25, of suburban Pacific Palisades, filed the 45-page complaint in Superior Court, listing nearly 300 defendants. They include every major auto maker in the world, airlines, airports, railroads, and a diversified portfolio of companies, plants, refineries and factories.

EXPERT SAYS MANY ADULT WOMEN TOO FAT, BAD TEETH COMMON

A malnutrition expert recently reported that 15 percent of adult women — rich and poor alike — are too fat, and all segments of the population suffer from bad teeth.

Dr. Arnold E. Schaefer, a Who is Who biochemist who is chief of the U. S. Public Health Service's nutrition program, said that well-to-do persons as well as the poor suffer from malnutrition.

The affluent have such problems as anemia, obesity and dental difficulties, Schaefer said in testimony in an interview.

Dedicated, intelligent and understanding leaders at the local and state levels can give us a strong national organization.

—JOE D. NICHOLS, M.D.

report—from the German sector floated into Dutch territory, laboratory tests showed they had bled at the gills and were killed by an intestinal infection not caused by bacteria or parasites.

ED. NOTE: The Dutch probably were angry with the Germans for this gift.

UTRECHT, June 25—The polluted waters of the Rhine, believed to have entered the river some 25 miles up-river from Coblenz, reached Holland yesterday. At once the big cities of Amsterdam, Rotterdam and Utrecht stopped taking water supplies from the river and switched to reserve stocks, said to be sufficient for a week.

ED. NOTE: This is the same as if St. Louis, Memphis and New Orleans were forced to stop using drinking water from the Mississippi.

AMSTERDAM—The poison in the Rhine has killed millions of fish—roach, chub, barbel, gudgeon, pike, carp and tench. The ducks have also been affected.

COLOGNE — Farmers have been warned not to let cattle graze on Rhineland fields.

PARIS — The experts estimate that five million fish have been killed. Squadrons of boats are plying the river scooping the fish as they float belly up towards the sea. The poison acts almost instantly by paralysing the nerves and stopping breathing. Fish used in laboratory tests with the polluted water died within seven minutes.

ED. NOTE: That's fast!

EDINBURGH — Scientists are carrying out tests to discover the origin of the pollution, and one theory is that a barge either dumped or dropped crates containing poison into the river. The fact that the pollution came in two waves would be explained by the crates breaking up at different times.

ED. NOTE: Experts to the rescue. Where were they when we needed them?

PARIS—As the polluted waters began flowing into the North Sea, Dutch and Belgian inshore fishermen were warned tonight to stay clear so as not to net affected fish by accident.

ED. NOTE: One wonders if they stayed completely clear.

CHAPTER FOUR

Upstream, the worst is believed to be over as the Rhine, fed by many mountain streams, flushes away the poison. But the experts say it will be at least five years before the natural balance of the affected water is restored.

ED. NOTE: The experts are now speaking of natural balance. One wonders if they are concerned by the millions of pounds of agricultural chemicals already used in the fields of the area.

ED. NOTE: These quotes are a small sampling of the news. Needless to say, the entire continent was "up in arms."

EPILOGUE

The Next Week:

It was discovered this week that the trouble on the Rhine was caused by two barrels of Endosulfan dropped from a barge in the river in 1967.

It's July 1969, Europe goes about business with the enthusiasm brought about by beautiful spring days, carefree people work and play as if all the world was at peace with nature. Mr. Common Man is no longer worried about the poison in the river and the experts are hard at work on another problem. HO HUM . . .

ED. NOTE: Man has been conducting a chemical warfare with insects all over the world. There is mounting concern that the eventual loser could be man himself. The poison in the Rhine is just a small sample of what can or might happen. Will the Mississippi or the Missouri or the Rio Grande river be next? We cannot know, but we can be sure that the experts are hard at work. ●

Watch On

A Play In Four Acts

The Rhine

By Tom Lavin

PROLOGUE

It's summer 1969

It's June, 1969, Europe goes about business with the enthusiasm brought about by beautiful Spring days, carefree people work and play as if all the world was at peace with nature. Sure, there had been those who had warned for years about the dangers of using powerful chemicals in agriculture but surely these people were wrong. The experts had the situation well in hand, or at least they said they did until the following headlines appeared all over the continent in all the large newspapers:



Chemical pollution of the Rhine extends from St. Goar (1) to the North Sea (2).

CHAPTER ONE

June 19 — MYSTERY POISON NOTED IN RHINE RIVER

A few fish were dying in the Singer section of France, located on the Rhine River. A few fishermen were concerned but the public went on with business as usual. The weekend news pushed this story from the newspapers but on June 25 the following headlines appeared:

CHAPTER TWO

London Daily Mail

POISON PERIL SWEEPS DOWN THE RHINE

The Times (London)

RHINE LOCKS ARE CLOSED IN BATTLE AGAINST POISON

(The headlines above are a sample of what appeared in every newspaper in Europe.)

The public was now concerned—in many areas the concern almost reached panic proportions.

CHAPTER THREE

HERE IS A SAMPLING OF WHAT THE PUBLIC READ IN THE NEWSPAPERS:

BONN — Thousands of police warned campers and barge-crews on the Rhine yesterday not to use the river's polluted water for any purpose. Since Thursday (June 19) a mystery poison which is still defying analysts has contaminated 250 miles of the river, one of the world's greatest industrial arteries. *ED. NOTE: This is equal to the distance on the Mississippi from St. Louis to Memphis.*

BINGEN—As millions of dead fish—40 million according to one

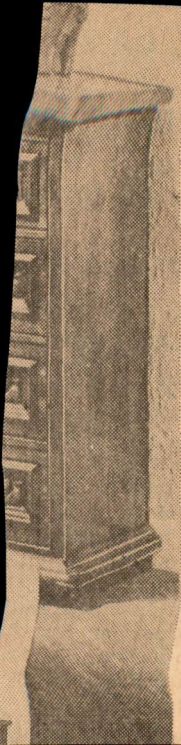
Car Firms Sued by Los Angeles

Los Angeles, Calif. —AP— Los Angeles county has intervened in a federal suit against major auto makers over smog devices, asking \$100 million in damages.

According to one official, the move was made to insure that the case is not settled out of public view.

A complaint petition to join the suit brought Jan. 10 by United States Atty. Matt Byrne was filed in federal court. If Byrne accepts the petition, county representatives *will be able to examine witnesses and add testimony.*

The suit accuses Ford, General Motors and Chrysler of conspiring to delay development and installation of effective smog control devices.



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Half the solution to pollution is just
sympathy by courts with victims.



7 - Air Polln. paper

June 22, 1965

Mr. Edward Ullman
University of Washington
Seattle, Washington 98105

Dear Ed:

I am flattered to get a carefully considered refutation from you and I hasten to comment on it. You bring out several tough points for debate.

A. Under your assumptions of a city with double the area I think the trips by car would increase by more than the square root of 2.

1. More trips would be made by car instead of walking at the greater distances, children to school, wives to market, families to church, businessmen from one plant to another, travelers from passenger terminals to hotels, etc.
2. As you point out, public transportation would be used less. You might also consider that the public transportation that is used could be made less polluting if trackless trolleys could be kept instead of internal combustion motors.
3. You might have noted that the use of vertical transportation in the more compact city would substitute for many trips now made horizontally on public streets.
4. A lower degree of centralization in the less compact city should increase the number of trips, since a shopper would require visiting several market places where one or two were enough before. As for starting and stopping, here again I think you are implicitly forgetting that we are comparing two cities rather than two different parts of the same city, and I do not think our assumptions give us any reduction in the number of traffic signals. On the contrary, less centralization means an increase in cross traffic, which means more stopping and starting for a trip of any given number of contacts.

Mr. Edward Ullman

-2-

June 22, 1965

B. You are assuming that the only source of pollution that is affected by low density is that from auto transportation. I tried to suggest in my paper that other sources of pollution also tend to increase. First, there is greater reliance on incineration as available dump sites get farther away.

C. A key question will always be the relationship between the given percentage of increase in emissions and the resulting percentage of deterioration in air quality as it affects human beings. I suggested in my paper that population dispersion is a good principle when the condition of the ambient air is not very polluted, but when it is highly polluted a decline of, say 50% in emissions per cubic acre of air might not improve air quality significantly.

D. Besides the question of proportions of pollutants to air, there is the question of scale of the city, and again you do not touch on the arguments which I made in that connection.

maintain
Some time when I get carried away I wonder why it is that when I drive out into the country I see so little air pollution compared with the city, but I am really not trying to ~~complain~~ that cities don't have something to do with it, and I appreciate your protecting me against my natural weakness for overstatement. Incidentally, Tom Crocker is working on a serious air pollution problem in a citrus-growing area in Florida which is entirely rural, but I do not take that as a typical case.

Sincerely yours,

Mason Gaffney
Chairman

MG bg

7 with my reply

UNIVERSITY OF WASHINGTON

SEATTLE, WASHINGTON 98105

The Graduate School
Office of the Dean

June 18, 1965

Professor Mason Gaffney, Chairman
Department of Economics
University of Wisconsin
Milwaukee, Wisconsin 53211

Dear Mase:

In regard to your statement: "... if you have a given number of people and given natural conditions, is the pollution problem ameliorated by reducing the over-all density? In a city as a whole, pollution at the center is contributed to by sprawl at the outskirts, and so the city must be evaluated as a whole."

Assume two cities of the same population and all traffic by auto, but one covering twice as much area as the other:

- 1) If all pollution comes from autos, then city covering twice as much area might be presumed to have just as much pollution per capita, but actually it will be less, because average trip length will not increase proportionately. Doubling area should result only in increasing trips by $\sqrt{2}$ (theoretically) or 1.41 times, or only about 70% of two times. (Empirically should be even less, because of re-arrangement of land uses, and/or fewer trips because longer?) However, let us assume only about 70% as much pollution per capita.
- 2) A still further reduction is needed because not all pollution comes from autos. In Los Angeles, the highest, the estimate is 80% auto pollution, 20% other, because of use of natural gas, strict control, etc. Most experts consider this the ineducible practical minimum. A lower range is Philadelphia or some other place where less than 1/3 is estimated from autos. These figures are rough, but no matter. In doubling the area thus we get a range of 56% (80% of 70%) for Los Angeles type, down to about 21% (30% of 70%). In practice even these figures probably understate lowering in pollution per capita because the major air pollution from autos comes from stops, starts, and idling, which would be relatively greater on short trips, or in a compact city. On the other hand, rush-hour traffic jams would produce a lot. Desideratum is to keep traffic moving—freeways help, and rapid transit for rush hour also.

Professor Mason Gaffney
June 18, 1965

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3) An important trade-off revising the pollution level upward from our 21-56% estimate, of course, is the greater use of transit in a compact city. For transit to be used, people need to be close to stops; dense corridors along routes, or dense islands at stops and a large downtown favor transit, in fact are essential if it is to get enough riders to do any good for congestion or pollution.

I forget the figures on greater use of transit in compact cities. For Chicago (CATS) 22% of person trips are transit. Rail-subway-el trips (5.3% of total) are somewhat longer (average c.9 miles). Bus (16.5% of total) and auto (78% of total) shorter (c.3.4 miles), but autos have c.1.5 passengers each, so that even if transit accounts for a higher percentage of passenger miles, resulting in some 15% of total for rail-subway-el, + 16.5% bus = 30% mass transit passenger miles, 70% auto, but number in cars (1.5 per vehicle) gives us an index of 105 for auto and a total of 135 including transit; converting back to parts of 100 results in about 22% of "pollution reducing" passenger miles via transit? Assume a doubling of transit proportion for a very compact city, an "ideal" impossible to realize, and one has 44% (56% auto); assume $\frac{1}{2}$ for a spread city = 11% (89% auto) or a difference of about 90% less use of autos in a compact versus a spread city, and we still get a range of 38% (21 + 90%) to 106% (56 + 90%). (And this assumes no pollution from buses!) As another comparison I seem to recall that percentage of work trips via mass transit reported in 1960 census (work trips = c. 40% of total), ranges from 7% in Los Angeles to 50% in New York City. Work trips are more mass transit than others, so our hypothetical range above (38 to 106%) appears to be the same order of magnitude?

All above is very rough, and I may have goofed somewhere, but I believe I err conservatively.

Therefore, conservatively I estimate doubling the area of a city and keeping population same, reduces pollution to as much as 38% per capita, and at the worst keeps it approximately constant, with the average somewhat in between. Other variations in density would be proportionate. This is an argument for decentralizing cities as far as air pollution goes. The only fair measure is the effect on people.

Professor Mason Gaffney
June 18, 1965

page 3

The whole question of spread versus compact city, auto versus mass transit, is up for grabs and I don't wish to take a doctrinaire position in favor of spread and democracy, but the advocates of compact, on the other hand, have the obligation to prove their case.

As I said before, I wish you would stop writing so I would not have to think so much. Seriously, of course, I mean just the reverse. You stimulate me. Thanks. Would love to talk to your group sometime --maybe next year.

Sincerely,



Edward L. Ullman
Associate Dean

P.S.

I also seem to recall that air pollution by and large is worse in European cities than U.S. (Compact cities--Copenhagen Conference as reported in National Air Pollution Conference, 1962).

PPS I guess what I have done is
is prove that putting in
transit will not cut down
av. per capita pollution!