THE DEATH OF THE OCEANS

Text of Luncheon Address Given To:

Commonwealth Club of California

March 13, 1970

By

Professor David Epel
Hopkins Marine Station of Stanford University
Pacific Grove, California

What I am going to tell you today may seem difficult to believe. Indeed, being an optimist, I find it hard to believe myself. But, being a scientist, I have tried to objectively analyze the data and have come to the following two conclusions: The first is that the oceans are beginning to die from chemical pollution; the second--and even more disturbing--is that NOTHING is being done about it; very few people know about it; -- no one is watching the world. This chemical contamination has begun to wipe out some species of oceanic birds. If left uncontrolled it will result in the death of the oceans.

This contamination is not only the very visible oil pollution we are hearing so much about these days. What I'm most concerned about, and what I want to discuss today, is the invisible contamination of the oceans by long-lived chemicals. For the remainder of this talk I want to discuss first the problem, and second, what can be done about it.

I fully realize that this whole concept of oceanic contamination is difficult to imagine. Let's face it; when we talk of pollution of the seemingly endless oceans, we are really talking about global pollution. But in fact, there are already two well-documented examples of the chemical contamination of our entire planet.

The first was that resulting from Strontium^{90} (Sr^{90}) and other isotopes released during nuclear testing. How did it happen? First, this radioactive isotope was released into the atmosphere. There it was carried by global wind patterns all

over the earth to come down with rain and dust as radioactive fallout. Because Strontium is almost like calcium, it was concentrated by living organisms and thus got into our food. When we ate this contaminated food, the Sr^{90}, being like calcium, tended to concentrate in bone. Being radioactive, continued exposure to this radiation would have resulted in an increased incidence of cancer. Because of this global contamination by Sr^{90} and other radioactive elements, an international agreement was made to stop atmospheric nuclear testing.

The next example--which is still all too current--is the global pollution by DDT. How did this happen? First of all DDT is also a long-lived chemical--just as the half-life of Sr^{90} is 19 years, the half-life for DDT is between 10 and 30 years. Secondly, DDT is also released into the air during spraying or evaporates into the air after spraying. It too, is concentrated by living organisms and tends to increase in concentration higher up in the food chain.

How does it get to such high levels? First, it is fat-soluble, and even if present in minute amounts, the marine animals concentrate it--they literally scoop it up--from the water. Second, it is not easily metabolized. The organisms cannot break it down or excrete it. Thus, DDT gets into microscopic sea plants. The sea plants--with their DDT--are eaten by small fish. These fish--with their DDT--are eaten by still larger fish. Thus the DDT level gets higher and the highest levels are in those animals at the tops of food chains--such as the fish-eating birds.

The reasons this contamination is of such concern is that DDT is a poisonous chemical--which, of course, is the reason it is used as an insecticide. The farmer assumes it stays in or near the field where he sprayed it. The contamination of the globe by DDT tells us that this is not the case.

Now did anyone in any government realize the extent of this pollution? There were quite a few clues. First, DDT was found in Antarctic penguins; it was found in Arctic seals and whales as well as in Eskimos. In other words, in areas where it was never used. One would think that government agencies responsible for our welfare would have therefore looked at the oceans; but instead the bulk of government surveillance was with freshwater and terrestrial organisms.

Then, the first solid evidence for the massive extent of this global pollution came from the laboratories of several university scientists, who looked beyond the immediate and more dramatic fish and bird kills. Through their investigations it has become apparent that the oceans are heavily polluted with DDT. The most extensive survey has been made along the Pacific coast. The basic--and most surprising--finding is that the contamination of the coastal ocean is as great--or greater--than many freshwater areas. For example, it has been highly publicized that Lake Michigan coho salmon are too heavily contaminated with DDT to be sold in interstate commerce. Similarly--and shockingly--Pacific coast jack mackerel can also no longer be canned for human consumption. The Food and Drug

tration has esc[redacted]ntially halted all canning of jack
l in southern C[redacted]lifornia. This is the death of an
fishery.

DT has gotten a[redacted]ay; it has escaped. What effects will
xic chemical hav[redacted]e? It has now been found that marine
which have the [redacted]ighest DDT concentration, cannot re-
properly. Br[redacted]n pelicans nesting in California are
ing eggs whose s[redacted]nells are too thin--the chicks never
Of two hundred [redacted] nests examined last year on Anacapa
only two conta[redacted]ned normal eggs. The rest were all
d, dehydrated, [redacted]ad. Thus, as the present adult gen-
dies off, they [redacted] will not be replaced.

bviously the bi[redacted]ds are getting this DDT from somewhere,
ir source is fi[redacted]. What effect is this DDT having on
h? We don't kn[redacted]. Studies on freshwater trout show
w levels of DDT [redacted]also result in reproductive failure,
a completely di[redacted]ferent mechanism than in birds. We do
w whether fish [redacted]n the ocean are also suffering from DDT
y. I am concern[redacted]ed, however, because so many of the
isheries--especi[redacted]ally off of California--are in a process
d decline. Thus[redacted] the sardine fishery--once the largest
world--is gone. The pacific mackerel catch is drasti-
own, and has fai[redacted]led to reproduce properly for the past
rs. The jack ma[redacted]ckerel don't seem to be suffering from
t the levels are [redacted] so high they're unfit for human con-
n. The anchovy [redacted]s one of the most abundant coastal
Although not s[redacted]o badly contaminated in northern

fornia, the DDT levels in [redacted]outhern California anchovy are
e times the FDA limit.

What are the main lesso[redacted] from the DDT story? There are
The first is that the c[redacted]ans are the toilets of the world,
the second is that it is [redacted]ry easy to pollute them. Fresh-
r lakes and streams repla[redacted] their water every few months
very few years. However, [redacted]here is no plug in the bottom
he sea. Thus, any persis[redacted]nt chemicals released into the
ronment can--and are--enc[redacted] up in our oceans. If they are
c and are concentrated by [redacted]rganisms, these chemicals will
m environmental hazards.

Okay, given these two e[redacted]mples of global pollution, one
d think that national and [redacted]nternational agencies would be
toring the oceans, would [redacted] watching the world. Well, if
ne is, it's a well-kept [redacted]ret. The fact is that there
no such agencies and that [redacted]ne only systematic programs of
d-watching are presently [redacted]ming from inadequately-funded
ersity research.

What have these researc[redacted]rs found? First, as I already
ioned, DDT and its deriva[redacted]ves are being found all over
globe.

Secondly, a group of i[redacted]strial chemicals, chemically re-
d to DDT, are also being [redacted]und everywhere. These chemicals
known as polychlorinated [redacted]phenyls, or abbreviated as PCB's.
are used as electrical [redacted]ulators, as cutting oils, and as
sticizers. Hundreds of mi[redacted]ions of pounds of these chemicals
been produced and they [redacted]e somehow escaped. Their con-
trations are very high in [redacted]ganisms along the Atlantic and

DSW 282037

: coasts. In the North Sea o[redacted]off of England they are
:d to have caused a very larg[redacted]e bird kill last year, in-
; tens of thousands of birds. [redacted] These are more birds than
.lled by oil off of Santa Bar[redacted]bara! These compounds are
It is not clear how they ha[redacted]ave escaped. Just as they
:en found in wildlife, they [redacted]are also found in ourselves,
ıns, and in human milk.
'hirdly, the heavy metal, lea[redacted]ad, may also be a problem.
ıan a half-billion pounds of [redacted] lead are released each year
ıe air during the combustion [redacted] of gasoline. This lead
:rom the gas additive tetraet[redacted]thyl lead. It too is escap-
:o the world. Research from [redacted] Caltech and the Scripps
ıte of Oceanography has shown [redacted]n that large amounts of lead
: are in snow in Greenland, [redacted]and that the oceans contain
.gh lead concentrations near [redacted] coastal cities, such as
ɟeles.
ıead is also poisonous. Like[redacted]e DDT, it too can be concen-
by marine organisms. Given [redacted] these facts, is any govern-
agency looking after our sa[redacted]fety and examining the lead
: in marine organisms? If th[redacted]ney are, they are keeping it
ɛt.
'ourth, what about radioacti[redacted]ve isotopes? This problem
ɛcome more severe in the futu[redacted]ure as nuclear reactors are
ɔed. Who will look for globa[redacted]al pollution by isotopes
ɛd by these reactors? What [redacted] will happen to the results
ir studies? If there is a da[redacted]anger, will anything be done?

DSW 282038

nswer that. If we continue with our presently inadequate of world-watching, little more will be done in the future as been done in the past.

Obviously, something must be done to correct this situa- since the preceding examples show the ease with which the can be polluted. I would like to propose a four-point m. (1) First and most pressing is the establishment of ernational commission or agency to watch the world. This has to be international, since this global pollution ts no national boundaries. Thus, the only manufacturer PCB's in the U.S. is Monsanto Chemical; but they are y other chemical companies in Germany, France and Japan. to is apparently trying to find out how the PCB's are ng and to provide substitutes. But will they? I don't Will responsible actions be taken by the other companies an and France? Obviously some sorts of international ls are needed.

I propose that we consider the establishment of an envi- tal FDA (an environmental Food and Drug Administration). n environmental FDA should examine all persistent chemicals are being produced and capable of being released into the nment. They must determine if they can be concentrated anisms, such as is happening with DDT and the PCB's. data must be made public. This agency must have the ity to stop the manufacture or release of potential nmental chemicals.

DSW 282039

An example of the need to examine all long-lived chemicals
ed in large quantity can be seen in the detective story
g to the discovery of the global contamination by the PCB's.
B's were discovered by chance. They fortunately happen to
lyzed by the same methods used in DDT analysis. The PCB's
ept cropping up as unknown peaks on the graphs. What were
strange peaks? Were they an unknown insecticide? Were
ome natural and unknown compound? Were they a new pol-
? Finally, through painstaking work here and in Sweden,
ere identified as the PCB's.

Are there other unknown chemical contaminants which are
ng into the world? We were lucky to find the PCB's. Might
be others? We must establish some sort of international
w. We can't wait until 1972 when the United Nations be-
o look at the global environment.

(2) Secondly, we must make international treaties or es-
h international agencies regulating the types of cargoes
can ply the oceans. Basically, such regulations are no
ent than those governing transport of explosives over
s. Such agencies would never have allowed construction
present generation of supertankers, or at the least would
ostponed their use until methods were available to prevent
ills. Santa Barbara will be like nothing if one of these
ankers goes down. The amount of oil in one of these super-
s is about 20 times that released at Santa Barbara.
rmore, since the release would occur at one time, the
s could be even more disastrous.

DSW 282040

Even more frightening, however, are the present chemical
s being built for transporting liquid chemicals. These
s can carry millions of pounds of such chemicals as
ic acid, phenol, and aniline. As there are no laws
t bulk transport of biological poisons, these tankers
also be used for carrying pesticides or herbicides.
the chain of events last year following the loss of one
f insecticides on the Rhine River. A trail of dead fish
ed almost 100 miles from Germany into the Netherlands.
er the catastrophe if a tanker goes down that is loaded
erbicides or pesticides. The statistics are against us.
three years before the tanker Torrey Canyon sank in the
h Channel, tankers were involved in an average of two
nts per week, and one in ten resulted in oil spillage.
have to wait for a Texas City disaster before we begin
ulate international shipments of oil and such poisonous
als as herbicides and pesticides? The oceans are too
and our chemical technology too powerful to allow un-
ted transport of such powerful poisons.
Ladies and gentlemen, there are almost no laws, other
nose of economic expediency, governing the types of
s transported on the oceans. If we don't institute such
now can we expect anything less than the death of the
?

(3) The third part of this program is support of research
g to technology which does not result in long-lived con-
nts. This must come from both the universities and
e industry. Both basic and applied research are needed.

DSW 282041

nfortunately, the universiti[redacted]s are presently in a very
lt situation as regards basic[redacted] research. On the one hand
ocal minority concerned about[redacted] the harmful effects of
ogy. They have transposed t[redacted]ese fears to all basic and
research. They scream "no [redacted]asic research, no applied
h--all research ends up as u[redacted]timately destroying the
ment." On the other side is [redacted] the Federal Government which
e have technological problems[redacted]--let's cut the basic research
rease appropriations for appl[redacted]ied research."
his philosophy will get us no[redacted]where. Basic research is
nerstone of new technologies. As an example, let's
the alternatives to DDT and [redacted] other long-lived pesticides.
available? One of the most [redacted] promising and exciting are
of chemicals known as juveni[redacted]le hormones. These are
hormones which prevent the gr[redacted]owth of noxious insects.
iscovery resulted from basic [redacted] research on how caterpillars
into butterflies. It is the [redacted] sort of basic research that
wspaper columnists like to ma[redacted]ke fun of. Imagine what
py it is to ask "Why is the U[redacted].S. Government spending all
ney on how caterpillars turn [redacted] into butterflies?". Yet
s money incredibly well-spent[redacted] This research into cat-
r biology and embryology was [redacted] basic or non-mission oriented
h. No one said "go find an i[redacted]nsect hormone which can be
a pesticide." No one even k[redacted]new if there were such hor-
much less if they were suitab[redacted]le as pesticides. This
h, which has provided the mos[redacted] promising method of insect
in years, simply originated [redacted] from the curiosity about how

ırs can achieve that incredi[illegible]e transformation of a
warty worm into a beautiful [illegible]utterfly.
ılso need more basic researc[illegible] into forms of energy
ı which will not contaminate [illegible]he globe. I am extremely
about our emphasis and depen[illegible]ance on nuclear energy
:ic power. The problem of st[illegible]ring the enormous amounts
:tive waste may prove insurmo[illegible]ntable and we may ir-
' contaminate the globe.
ıeed more basic research into [illegible] non-contaminating forms
conversion, such as solar en[illegible]ergy. If you'll pardon
.s this "pie in the sky." Pr[illegible]obably not. Again--as
:aterpillar story--the signi[illegible]cant breakthrough will
basic research in physics, [illegible]hemistry, and biology--
ırch in the area of photochem[illegible]stry.
summary, I have pointed out t[illegible]he danger of chemical
in the oceans and I have ind[illegible]cated that no one is
:he world. We now have ample [illegible] warning that, if left
the death of the oceans wil[illegible] result. Coal miners
:e canaries down into the min[illegible]s with them to warn
)on monoxide poisoning. When [illegible] the canaries keeled
' knew they were in trouble a[illegible]nd better leave fast.
; have also shown us their can[illegible]aries. These are the
ıot reproducing because of DD[illegible] and North Sea birds
ıuse of PCB's. Can we afford [illegible] to wait for greater
)le tragedies?

DSW 282043

an immediate solution we nee[redacted]d first the immediate
hment of an international env[redacted]ironmental FDA to prevent
ase of long-lived chemicals [redacted]nto the environment;
we require treaties and agenc[redacted]ies to regulate the types
es which sail the seas; finai[redacted]ly, as both an immediate
-term solution, we need more [redacted]basic and applied research
to alternatives to our contam[redacted]inating technology.
ese are not insurmountable pr[redacted]oblems. As I have pointed
y, our chemical technology is [redacted] so powerful as to have
the globe and to have begun [redacted]the destruction of the
Surely, knowing this, our re[redacted]sponse can also be power-
gh to prevent such an occurre[redacted]nce.