Past aerosol campaigns and what have we learned? what we must improve?

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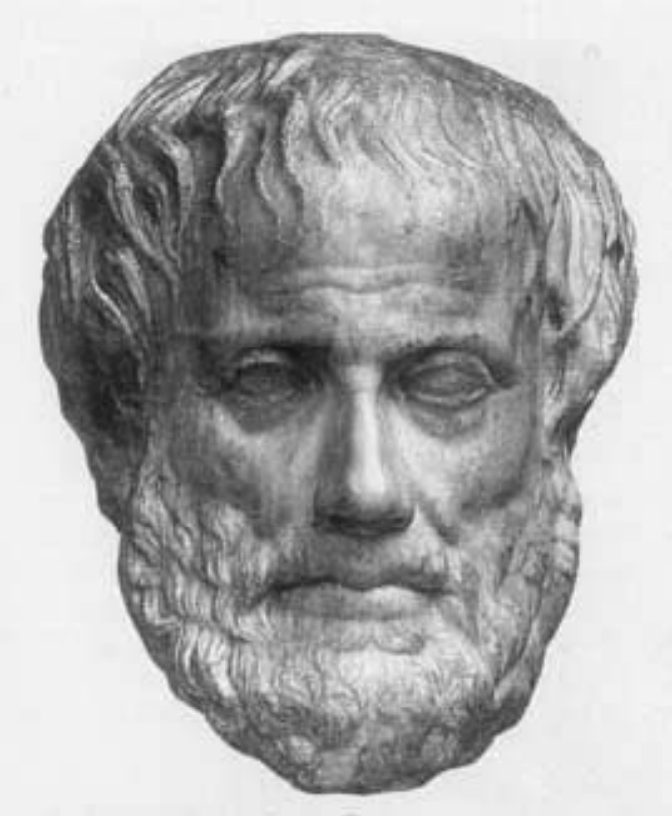
Origin of the word: Latin campus (field)
Late latin: campania (level district)
´ Italian: campagna
French: campagne

Military campaign: operation for a specific purpose (obviously in the flat country)
Sales campaign: systematic, aggressive activities to promote product
Political camapaign: intense effort to win election
Clean clothes campaign

Campaign associated with words like intensive, drive, effort, push, offensive.

In science: campaign is an intense effort of a larger group of
scientists, technicians, students,…
investigating in detail a specific problem

Why?
Greek philosopher Aristoteles (384 to 322 BC) :



Ἀριστοτέλης,

The whole is greater than the sum of its parts.

Each scientist is a specialist in his/her narrow field, thogether they know more,
if cooperating

Example:

Scientist 1:
Excellent knowledge on visibility and its relation to
aerosol composition, humidity, illumination, properties of eye, etc.
exact visibility measurement and documentation of variation
easily possible

Near power plant: visibility shows variation

→ influence by plume of generating station suspected

→ statistics, wind rose dependence, humidity, temperature dependence etc.

¡¡¡¡¡¡ not very exciting !!!!!!

Scientist 2: Specialist on condensation nuclei:

Upon supersaturation water (liquid) condenses on existing particles,
Nature and size of particles important
measurement of CCN is possible, but large variation
important source for CCNs is combustion

→ in powerplant plume high CCN number

Scientist 3: interested in spatial variation of the aerosol.
Developed instruments with short time response to fly on airplane.
Mapping of pollution (CCN, size distribution etc. possible)
Many data

If all three get together in a campaign:

Ground station measures CCN
Tracing of plume by airplane with fast CCN
Dispersion of plume can be measured by decrease of CCN
Visibility measurement correlated with plume status.

Quantitative assessment of power plant influence on visibility is possible
(not possible for single scientist)

Surprising result:

No visibility reduction by powerplant plume (<100 km from plant)

For successfull campaign needed

(1) A scientific problem to be addressed
(2) First planning:
Discussion of possible solutions to the problem
selection of instruments
and scientists
(3) If possible a pilot study
Evaluation of data and adjustment of science plan
(4) Final planning

Begin Campaign.

(come to site a few days ahead, calibrations, test measurement,
test evaluation)

Quality control and auditing
Planning meetings and data meetings every day
intermediate results will govern measurments to be performed
Gather as many data as possible during campaign

End Campaign.

Evaluation of data should start right ahead.
Make data availabe to other participants

First evaluation workshop:
Presentation of available data, accuracy, bad data
Discussion of possible joint papers.
Continue evaluation with respect to evaluation workshop
Second evaluation workshop: Bring half finished paper,
……
…...

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Campaign and money usually ends here

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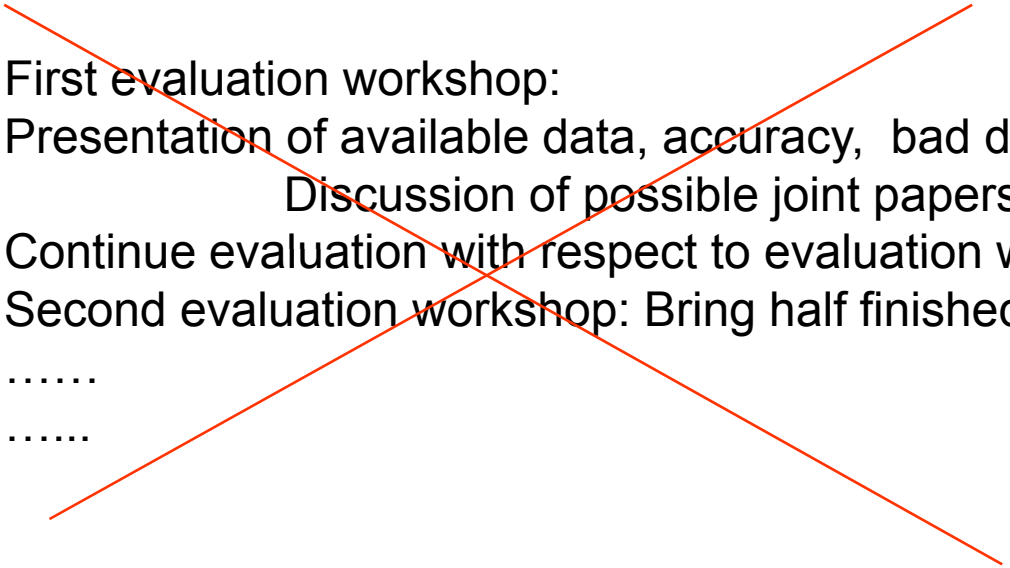


Example for a successful aerosol campaign:

ACHEX: Aerosol characterization experiment in Pasadena (Los Angeles) 1972/73

A well known problem

Los Angeles, 1958

Dense haze associated with photochemical processes in the air of Southern California.

Details about origin and nature of aerosols in the reactive mixture.

New available:

Size measurement (optic and electrical)
light scatteing instrument fully mobile
Size segregation
microchemical analysis most elements / compounds
Chemical mass balance

Pre study September 1969

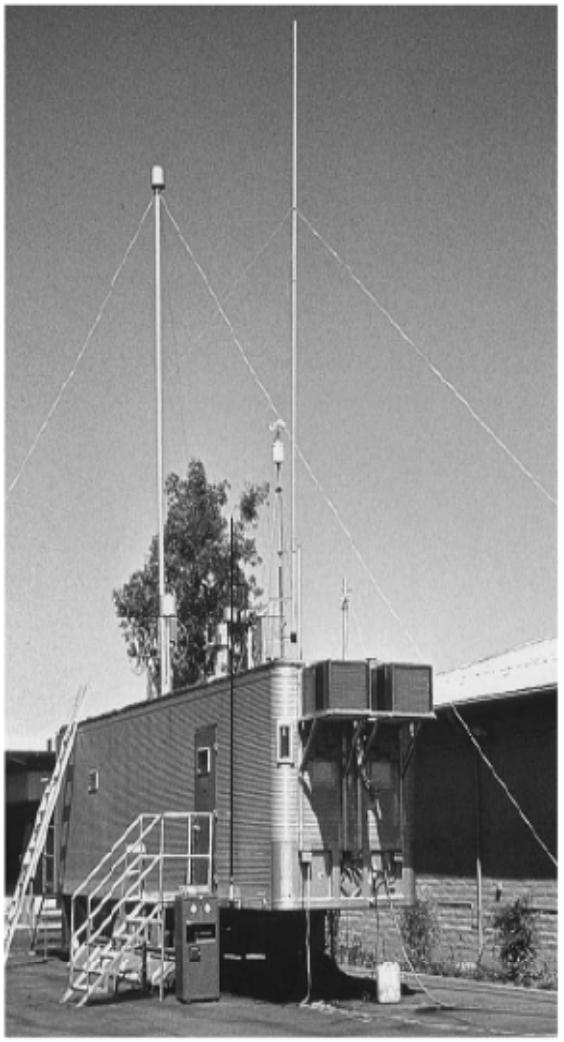
Kenneth Whitby
Sheldon Fiedlander
Robert Charlson
Peter Mueller

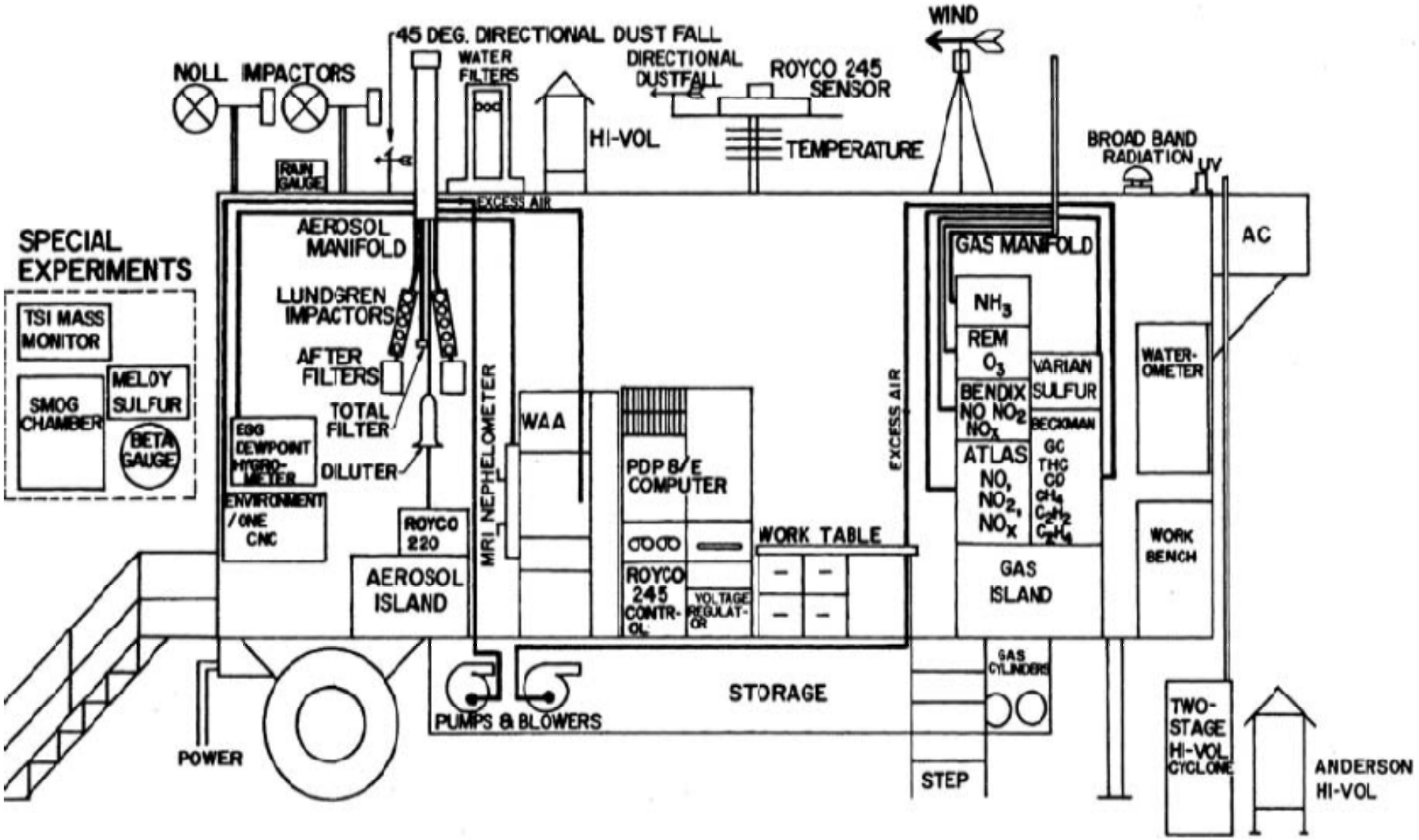
Sucessful in beginning to understand smog aerosol

After successful pre-study CARB (California Air Resource Board reserved
$ 2 Million (1970)

CARB felt that scientific community has insufficient
→ management by Rockwell international (Aer

Large mobile laboratory:




45 DEG. DIRECTIONAL DUST FALL
WIND
NOLL IMPACTORS
WATER FILTERS
DIRECTIONAL DUSTFALL
ROYCO 245 SENSOR
HI-VOL
TEMPERATURE
BROAD BAND RADIATION
UV
RAIN GAUGE
EXCESS AIR
SPECIAL EXPERIMENTS
TSI MASS MONITOR
MELOY SULFUR
SMOG CHAMBER
BETA GAUGE
AEROSOL MANIFOLD
LUNDGREN IMPACTORS
AFTER FILTERS
TOTAL FILTER
DILUTER
EGG DEWPOINT HYGRO-METER
ENVIRONMENT / ONE CNC
ROYCO 220
AEROSOL ISLAND
MRI NEPHELOMETER
WAA
PDP 8/E COMPUTER
ROYCO 245 CONTR-OL
VOLTAGE REGULAT-OR
WORK TABLE
EXCESS AIR
GAS MANIFOLD
NH3
REM O3
BENDIX NO NO2 NOX
VARIAN SULFUR
BECKMAN
ATLAS NO, NO2, NOX
GC THC CO CH4 C2H2 C2H4
GAS ISLAND
AC
WATER-OMETER
WORK BENCH
GAS CYLINDERS
STORAGE
PUMPS & BLOWERS
POWER
STEP
TWO-STAGE HI-VOL CYCLONE
ANDERSON HI-VOL

Snapshots of a variety of variety of atmospheric conditions

Source regions: vehicles, vegetation, desert, sea

receptor regions

In addtion to mobile laboratory: monitoring stations, aircraft measurements.

First frustration of ACHEX:

no smog in 1972

→ continuation in 1973

Many results:

Multimodal volume size distribution

link with photochemical processes and air chemistry

importance of secondary organic carbon in smog aerosol

chemical mass balance

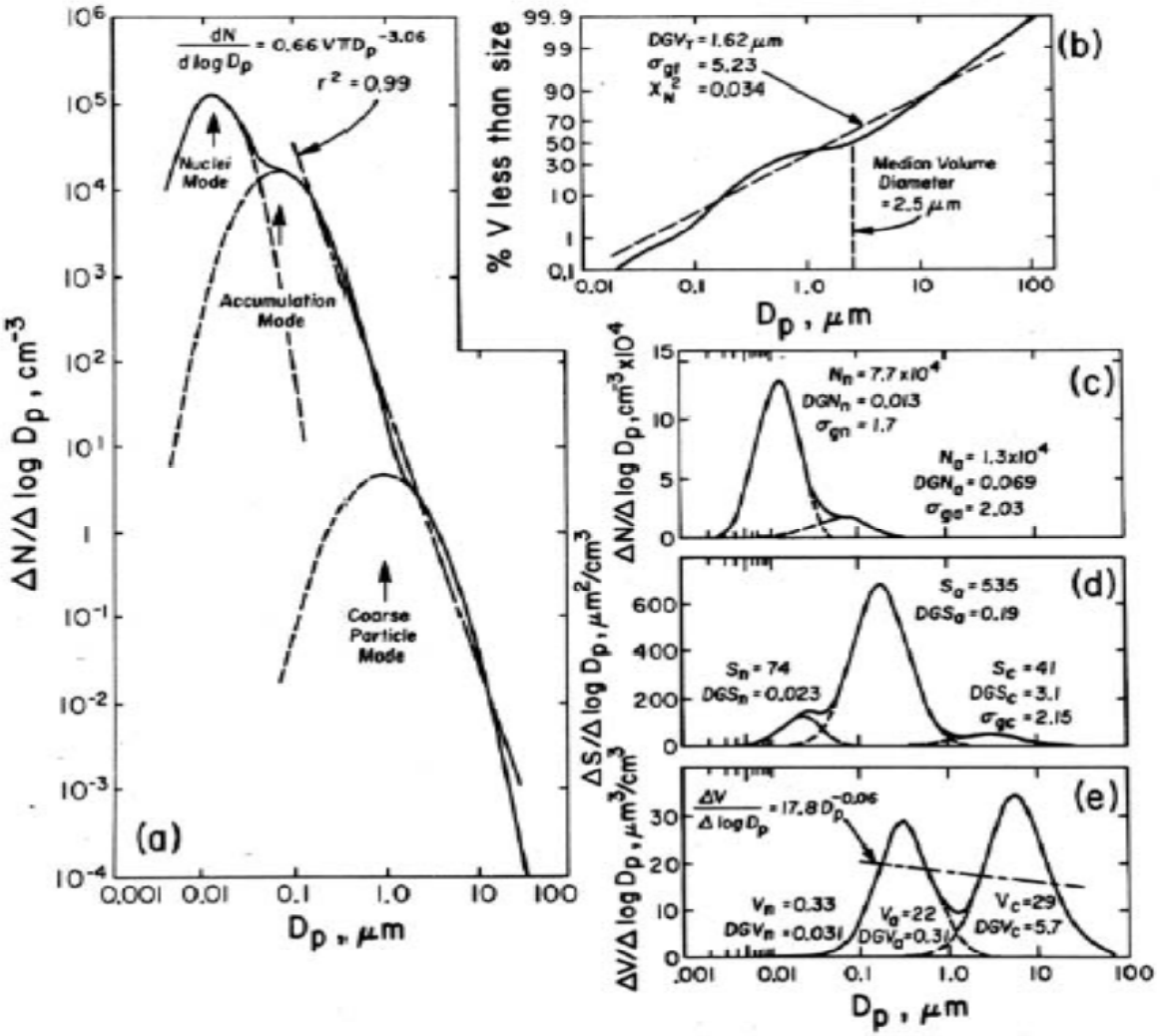


Figure 10. A single particle size distribution plotted five different ways to illustrate how features of the distribution can be emphasized or nearly hidden by the method of data presentation. In this example, an average urban aerosol distribution was fitted to a power law (left), a log-normal model (top right), and number, surface, and volume distributions that emphasize the modal nature of the aerosol.

Source: Whitby (1978) and Whitby & Sverdrup (1980). Reprinted with permission from George M. Hidy.

One of the many results of ACHEX

Other aerosol campaigns:

VISTTA (Visibility Impairment from Sulfur Transformation and Transport in the Atmosphere, 1979).
In the SW of the US : good visibility; do power plants disturb visibility??.
Ground based and airplane measurements:
Aerosol characterization In view of possible influences on visibility by power plants (emitting particles and SO2 and NOx).

Result: The power plant plume appearance is dominated by NO2, secondary aerosol formation can be neglected up to 100 km from the plant.

SCAQS Southern California air quality study 1987:

Develop comprehensive air quality and meteorological data base and use to test, evaluate and improve air quality simulation models for oxidants, PM-10, fine particles, toxic contaminants, acidic species.

Technical question regarding emission, transport transformation, deposition.

Monitoring mainly at existing sites + airborne and tracer measurements + additional locations.

ACE (Aerosol Characterization Experiments 1995 -2004; ACE-1, ACE-2, ACE-Asia,):
Network of ground stations + intensive field measurements + satellite observations + airplane measurements + models.
Study of the aerosol, its transport and its effect on the radiative balance,
E.g. 30 W/m2 for Asia for the clear sky.
Indirect effect have also been studied
…….
…….

Many other large projects.

Smaller Campaigns, limited to a specific geographic region or special scientific questions:
Just to name a few:

LACE 98 (Lindenberg Aerosol Characterization Experiment, 1998, Germany),

VELETA 2002 (e**V**aluation of the **E**ffects of e**L**evation and a**E**rosols on the ultraviole**T** r**A**diation, Granada, Spain);

GCE: Ground based Cloud Experiment: Near Bologna, Multiphase cloud processes,

Special land based campaign on aerosols, India, February 2004;

CARES (Carbonaceous Aerosols and Radiative Effect Study) Calfornia, June 2010.

An interesting project: Aerosol Campaign for schools 2013/14, which is part of the GLOBE (Global Learning and Observation to Benefit the Environment)

Financing of campaigns

(1) Funding agency is persuaded to finance campaign, scientists can apply and when accepted get funding

(2) Funding agency givens money to organizer managing the project, Organizer invites scientific groups to participate. Strict organisation possible.

(3) Interested sceintists get together and decide to make a campaign

Some remarks and personal experiences to campaigns

Pre campaign desirable
Much energy must be invested in planning
Strict and powerful management
Data must be available on time and to everybody (the whole is more than ist parts)
Agreement of publication
Communication between participants of campaign must be easy
(but not abused)
Post campaign workshops as important as workshops before campaign

Sufficient time (and money) for evaluation of data

Some remarks to the hard working participants of campaigns:

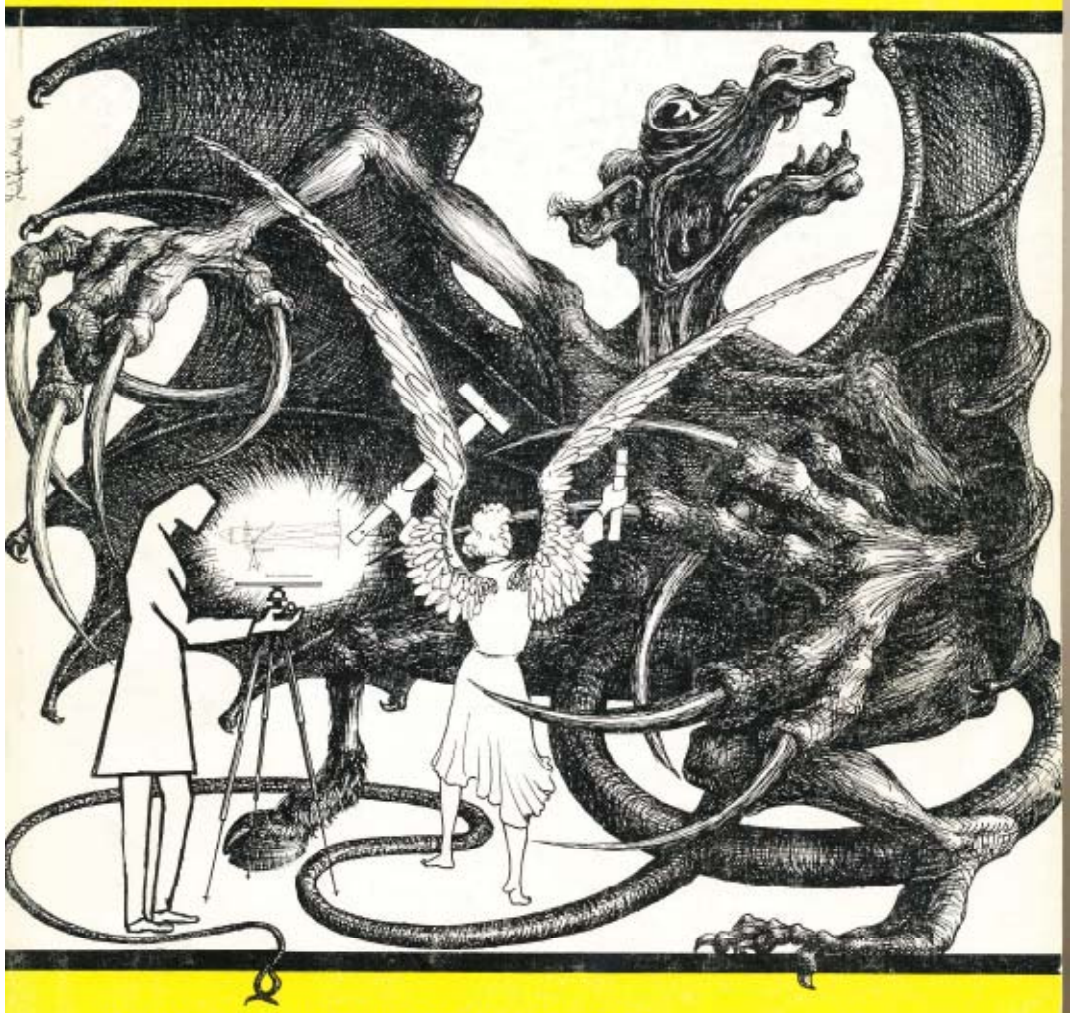
In a camapaign you are on your own and work alone
even if 50 other scientists work next to you

Hostile environment

J. Dason: Optics in a hostile environment Applied Optics 7(4), 1968, 569-580

Applied Optics

April
1968



OPTICS IN A HOSTILE ENVIRONMENT

Hostile environment:

Physical disturbing factors

Cases in which ist is difficult to use optics at all

Unskilled operators

Economic factor

Optical squares

Physical disturbing factors:

Temperature (-40 to + 60°C)

Temperature gradient, variation of refractive index

Humidity (up to 100%) e.g. fog deposit on lenses

dangerous for electronics

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Sunlight (stray light, is light in an optical system, which was not intended in the design

set a working limit on the dynamic range

thermal radiation

Darkness

Wind, Rain

Atmospheric instability

Vibrations (airplane),

airfreight (screws loosen)

Environmental chemicals (fog can have low pH value)

Representative sampling

is the sampled aerosol the same,as in the air?

Sampling artifacts (too much or too little??)

Is the sampled aerosol disturbed e.g. by

exhaust of electric generator

airplane exhaust

cars coming to the measuring site

Unskilled operators:

Usual procedure: Highly qualified scientist with many years of experience
puts together a perfect measuring system
a lot of work and knowledge is involved in getting it operational
small details matter!! (usually never published)
When operating well: supervision of measurement is simple
-→ unskilled operator is sent to the campaign
What if something unexpected happen?
(Does not know all small details)

Data must be evaluated immediately (decisive for next day measurement).
(difficult or impossible for unskilled operator)

Economical factors:

Lack of money may give less reliable data. Because

Not so perfect instrument

Not sufficient counteraction to hostile environment possible

Economical factors:

Lack of money may give less reliable data. Because

- Not so perfect instrument
- Not sufficient counteraction to hostile environment possible
- unskilled operators are cheaper

In a camapaign you are on your own and work alone

Hostile environment

despite the many other scientists around you you are alone

No laboratory infrastructure,

(Getting somethng out of the second drawer is not possible)

→carful planning needed,

- spare parts need to be there (you cannot wait)
- you must know your instrument by heart, and act if something goes wrong

no aprentices who know little about it

- Backup for everything: spare lamp, laser, boot programs, pump, laptop
- Tools and knowledge for repair
- Securing of data is important!!

Summary:

Campaign is a powerful tool for studying aerosols. Will give insight if well done
But remember: only a snapshot

- Preparation and planning
- Pre study
- management
- Try to avoid failures by redundance of instrumentation
- Auditing and quality control
- Secure data many times
- Ethics with publications
- Reserve sufficient time after campaign
- Expect failures (e.g. no smog)

Good luck with your next campaign!