

**28<sup>th</sup> ISIMS Conference**  
**Hannover, Germany**  
**July 28 – August 01, 2019**

**A tribute to**  
**James Ephraim Lovelock**  
**on the hundredth birthday anniversary**

## James Ephraime Lovelock – inventor, scientist and futurist



### **born:**

July 26, 1919 in Letchworth Garden City (UK)

### **education:**

Birkbeck College, University of Manchester, London School of Hygiene and Tropical Medicine (PhD, 1948)

### **workplaces:**

National Institute for Medical Research, Yale University, Baylor College of Medicine, Harvard University, Harvard Medical School, **Independent scientist**

### **awards and honors:**

Order of the British Empire, Order of the Companions of Honour, Fellow of the Royal Society, American Chemical Society Award in Chromatography and many, many other

### **THE MOST IMPORTANT AND COMMON-KNOWN ACHIEVEMENTS:**

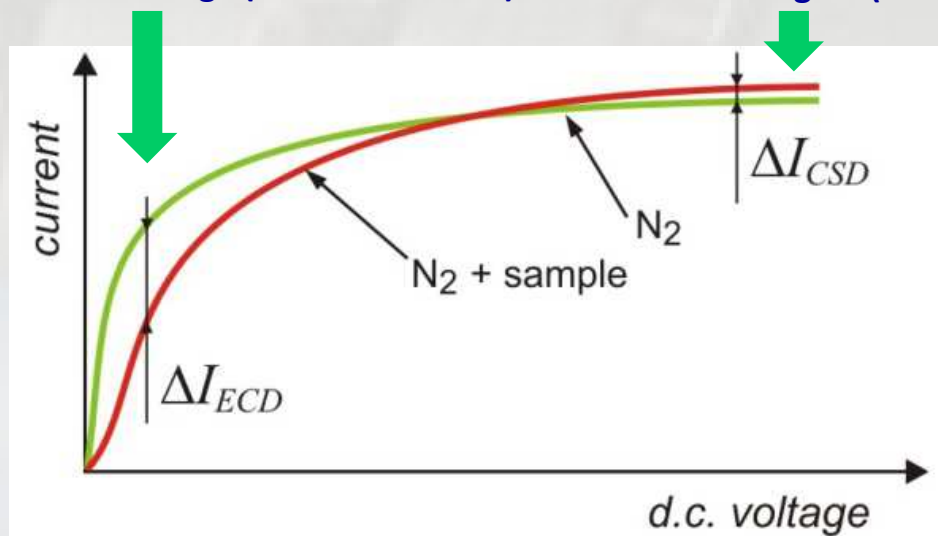
- **ELECTRON CAPTURE DETECTOR – sensitive detector for gas chromatography**
- **RESEARCH ON ATMOSPHERIC GAS POLLUTION – measurements of CFCs distribution**
- **GAIA HYPOTHESIS – new attempt to philosophy of nature**

# Inventing Electron Capture Detector (ECD) – how it was done?

current – voltage characteristic of radioionization detector

recombination range (ECD – d.c. mode)

saturation region (CSD)

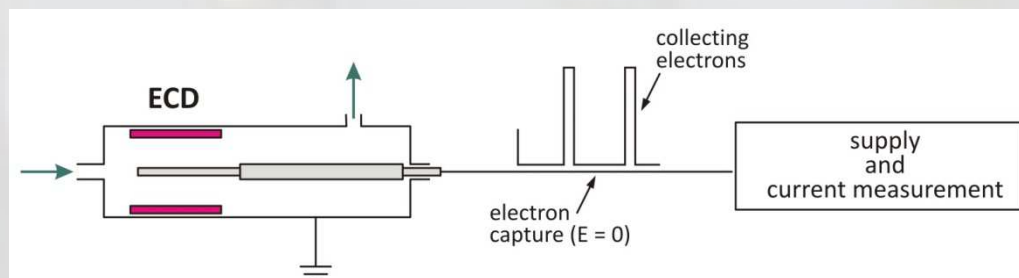


1957

Electron Capture Detector,  
Science Museum London

**J.E. Lovelock, S.R. Lipsky,**  
Electron affinity spectroscopy - a new method for  
the identification of functional groups in chemical  
compounds separated by gas chromatography,  
*J. Am. Chem. Soc.*, 82 (1960) 431-433

## ECD – pulse mode operation



**J.E. Lovelock,**  
Ionization methods for the analysis of gases  
and vapours, *Anal. Chem.*, 33 (1961) 162-178

# Environmental studies by J.E. Lovelock

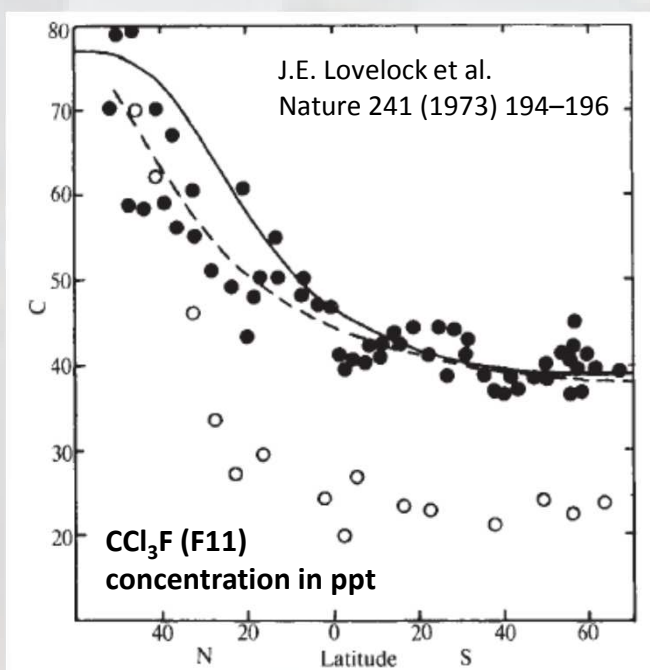
RSS Ernest Shackleton  
expedition to southern hemisphere



RV METEOR II expedition to Sargasso Sea



from A. Zlatkis, C.F. Poole, Electron Capture,  
Theory and Practice in Chromatography, J. Chrom. 20 (1981) 5.



## Substances to be detected:

$\text{CCl}_3\text{F}$ ,  $\text{CCl}_4$ ,  $\text{CH}_3\text{I}$ , peroxyacetyl nitrate,  $\text{NO}_x$   
dimethyl sulfide and other cloud-condensation nuclei

## Main conclusions:

1. ECD is very sensitive, the measurement results are repeatable, in some applications it is irreplaceable.  
**This was the first radioionization detector used successfully in analytics.**
2. Chemicals produced by man have a significant impact on the atmosphere, even if the amounts of these substances are trace.

J. Charlson, J.E. Lovelock, M.O. Andreae, S.G. Warren,  
Oceanic phytoplankton, atmospheric sulphur, cloud albedo  
and climate, Nature 326 (1987) 655–661

## ECD was used in explosives detectors



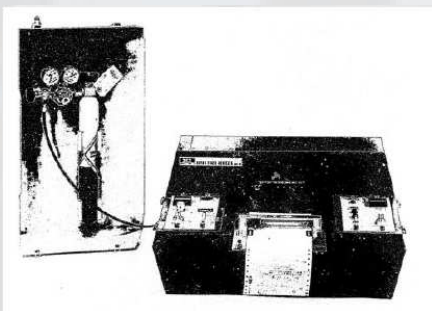
**Pye Dynamics  
PD1**



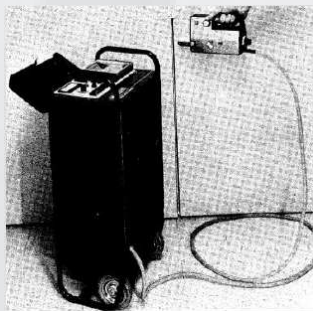
**Ion Track Instruments  
Model 70**



**Graseby Ionics  
PD4M**



**Hydronautic Israel  
Vapour Trace Analyzer 103A**

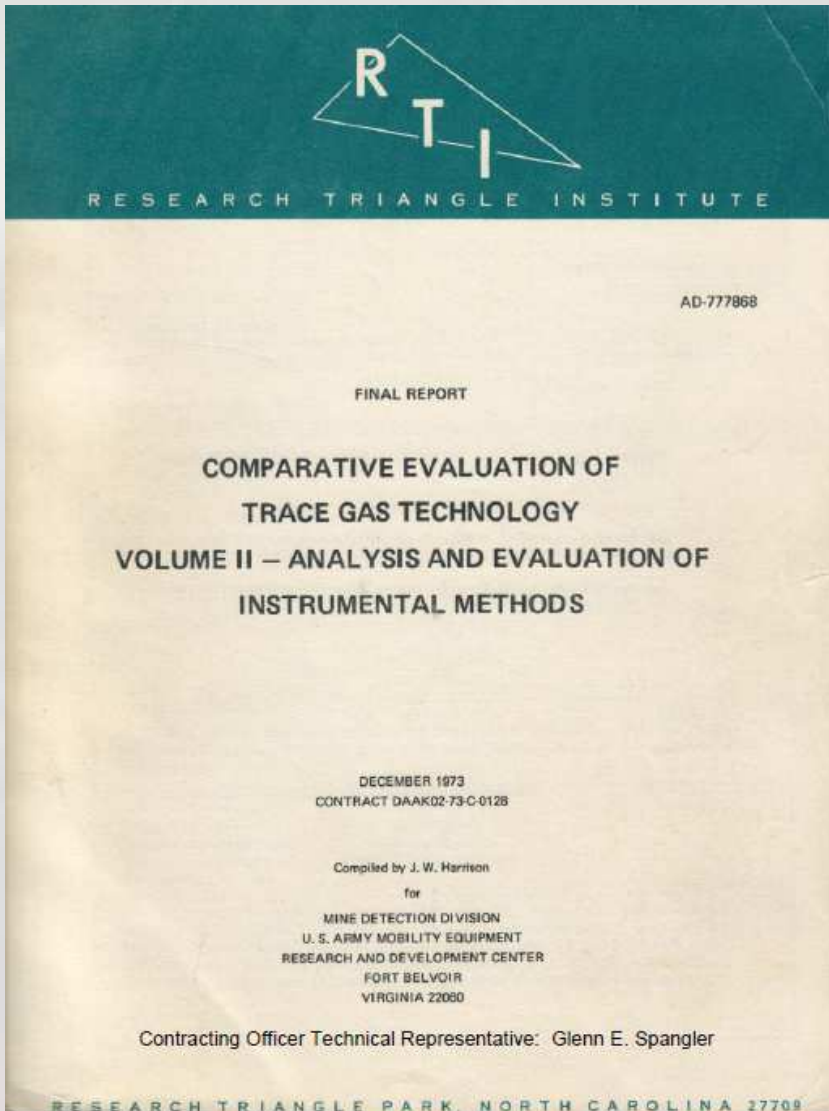


**Ion Trac Instruments  
Model 62**



**Scentor**

# Finally IMS technology was selected for hazmats detection



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## Electron capture in IMS detectors

- F.W. Karasek, O.S. Tatone, D.M. Kane, Study of electron capture behavior of substituted aromatics by plasma chromatography, Anal. Chem. 45 (1973) 1210-1214.  
F.W. Karasek, D.M. Kane, Effect of oxygen on response of the electron-capture detector, Anal. Chem. 45 (1973) 576-580.
- G.E. Spangler, P.A. Lawless, Comparison between Plasma Chromatography and Electron Capture Detector, Anal. Chem. 52 (1980) 193-196.
- F.W. Karasek, G.E. Spangler, Electron-capture process and ion mobility spectra in plasma chromatography, Chapter 15 in Electron capture, ed. A. Zlatkis and C.F. Poole, Elsevier 1981.
- E. E. Tarver, H. H. Hill Jr., Comparison of a pulsed electron capture detector and a Fourier transform ion mobility detector after capillary supercritical fluid chromatography, Fresenius J Anal Chem 344 (1992) 453 – 459.
- K.A. Daum, D.A. Atkinson, R.G. Ewing, The role of oxygen in the formation of TNT product ions in ion mobility spectrometry, Int. J. Mass Spectrom. 214 (2002) 257–267.
- M. Tabrizchi, A. Abedi, A Novel Use of Negative Ion Mobility Spectrometry for Measuring Electron Attachment Rates, J. Phys. Chem. A 108 (2004) 6319-6324.
- M. Kučera, M. Stano, J. Wnorowska, W. Barszczewska, D. Loffhagen, Š. Matejčík, Electron attachment to oxygen in nitrogen buffer gas at atmospheric pressure, Eur. Phys. J. D, 67 (2013) 1-8.
- Ch. Huang, B. Xu, W. Niu, H. Gao, Y. Hong, L. Xia, Y. Lu, Ch. Shen, Y. Chu, An experimental study of low energy electrons attachment to CH<sub>2</sub>ClBr using ion mobility spectrometry, Int. J. Mass Spectrom. 402 (2016) 29-35.
- E. Budzyńska, M. Grabka, J. Kopyra, M. Maziejuk, Z. Safaei, B. Fliszkiewicz, M. Wiśnik, J. Puton, Ion mobility spectrometers and electron capture detector – A comparison of detection capabilities, Talanta 194 (2019) 259–265.

and more ...

### Two problems:

- **Electric field in IMS detector is usually too high – energy of electrons is not optimal for attachment.**
- **The most popular way of ionizing chemical compounds in interactions with low energy electrons is the so-called dissociative capture. Unfortunately, as a result of this process, „uninteresting“ drift time spectra are created.**

# J.E. Lovelock and Gaia hypothesis (Gaia theory, Gaia principle)

## Basic idea:

The Earth can and should be seen as a complex system in which living organisms and the inorganic environment interact with each other. These interactions contain self-regulation mechanisms that allow the preservation of the conditions necessary for the existence of life on the planet.

In general, it is not the natural environment that created the conditions for the origin and expansion of the life: it is the living creatures who produce gas that allows them to survive, so the biosphere has the ability to control its natural, chemical and physical environment.

**The theory may be controversial, but Lovelock's works move people forcing them to think about the planet they live on.**

**And the range and coverage of these works are very wide ...**

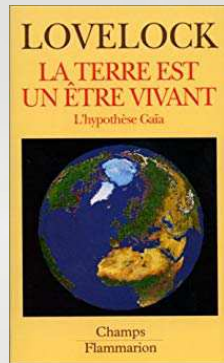




## James Ephraim Lovelock – about Earth and environment



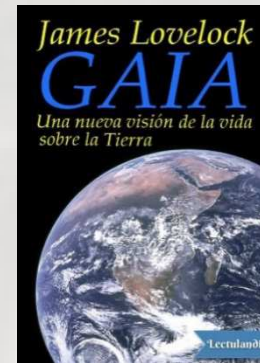
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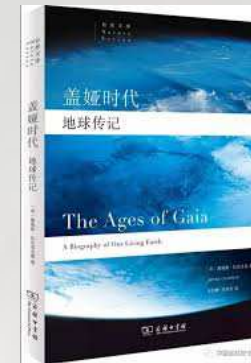
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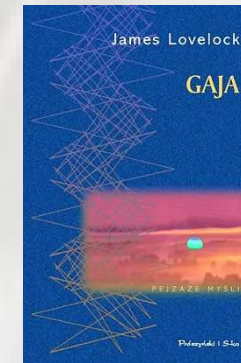
RUS



E



CHN



PL

## People about James Ephraim Lovelock:



ŁĄKI ŁAN (means: Lan of Meadow), Polish band playing electronic music, rock and funky, founded 2002, energetic, colorful and humorous

## LOVELOCK

text by Włodzimierz Dembowski

Łan łąki, one home, one hope, one goal,  
One ship, one wish, one way, one show,  
One body, one dance, one karma, one chance,  
One pulse, one spot, one destiny, one God!

...

I am James! James! James Lovelock!  
As hot as a nucleus, as light as a cloud

...

**4,221,107 views on YouTube!**

**Dear Professor Lovelock,  
we wish you many years in good health.  
Thank you for your ideas inspiring us in  
the field of analytics and also asking us  
to reflect on the world in which we live.**

**Participants of 28<sup>th</sup> ISIMS conference  
July 28 – August 01, 2019  
Hannover, Germany**



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