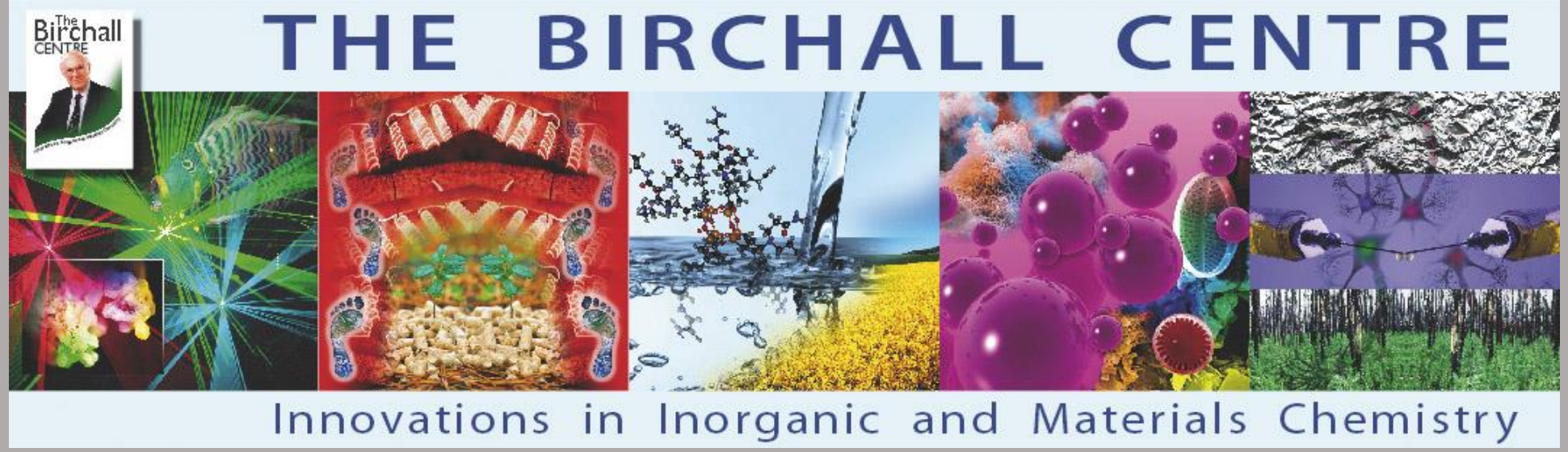


Aluminium Toxicity and Human Health

Christopher Exley PhD FRSB

The Birchall Centre, Lennard-Jones Laboratories, Keele University, Keele, Staffordshire, ST5 5BG, UK.

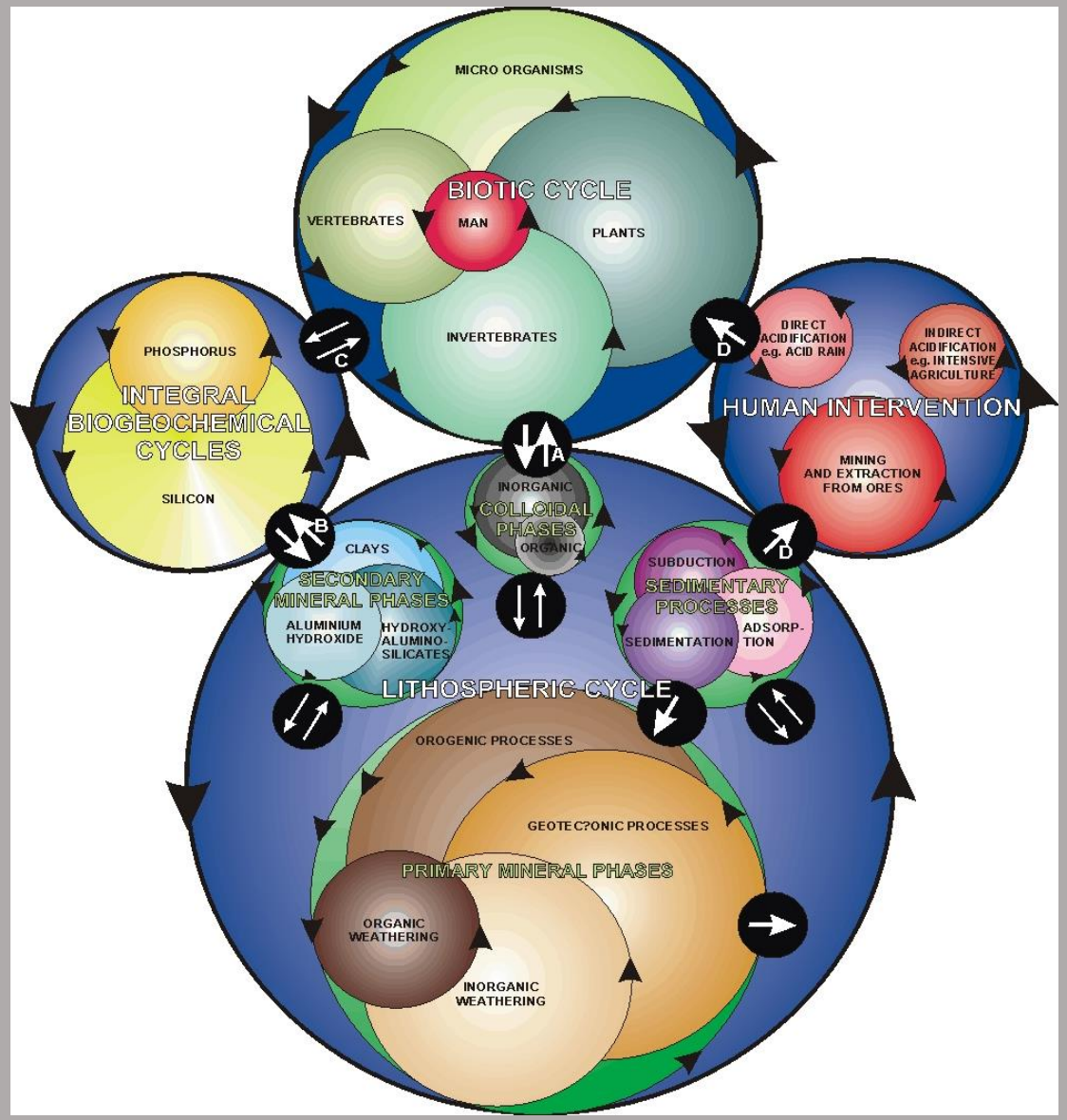
c.exley@keele.ac.uk

http://www.keele.ac.uk/aluminium/

https://www.hippocraticpost.com/?s=Exley

There is a true pandemic that devastates human lives each and every day.

That pandemic is our continuous and burgeoning exposure to aluminium.

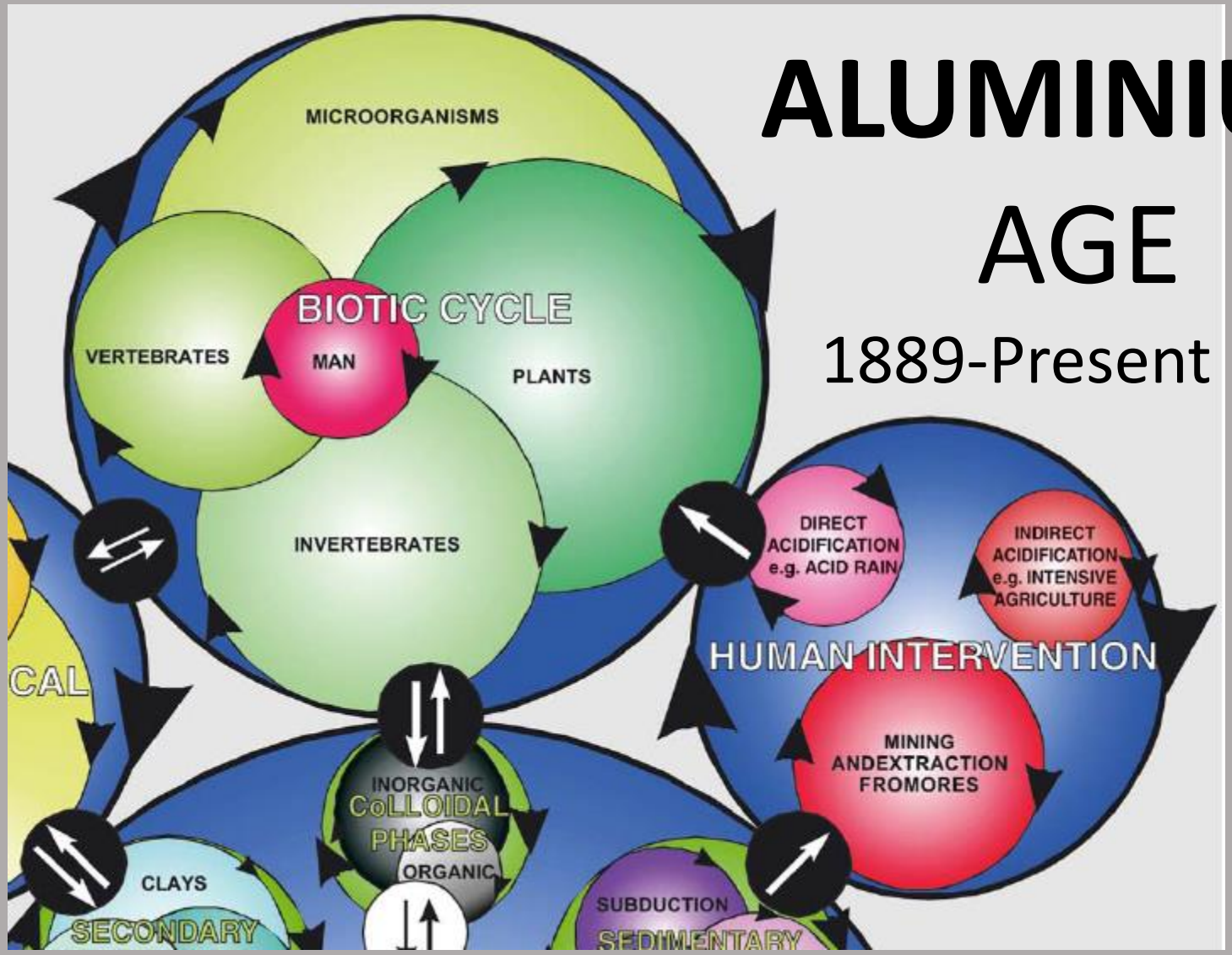


THE BIOGEOCHEMICAL CYCLE OF ALUMINIUM

Exley C (2003) A biogeochemical cycle for aluminium ? J. Inorg. Biochem. 97, 1-7.

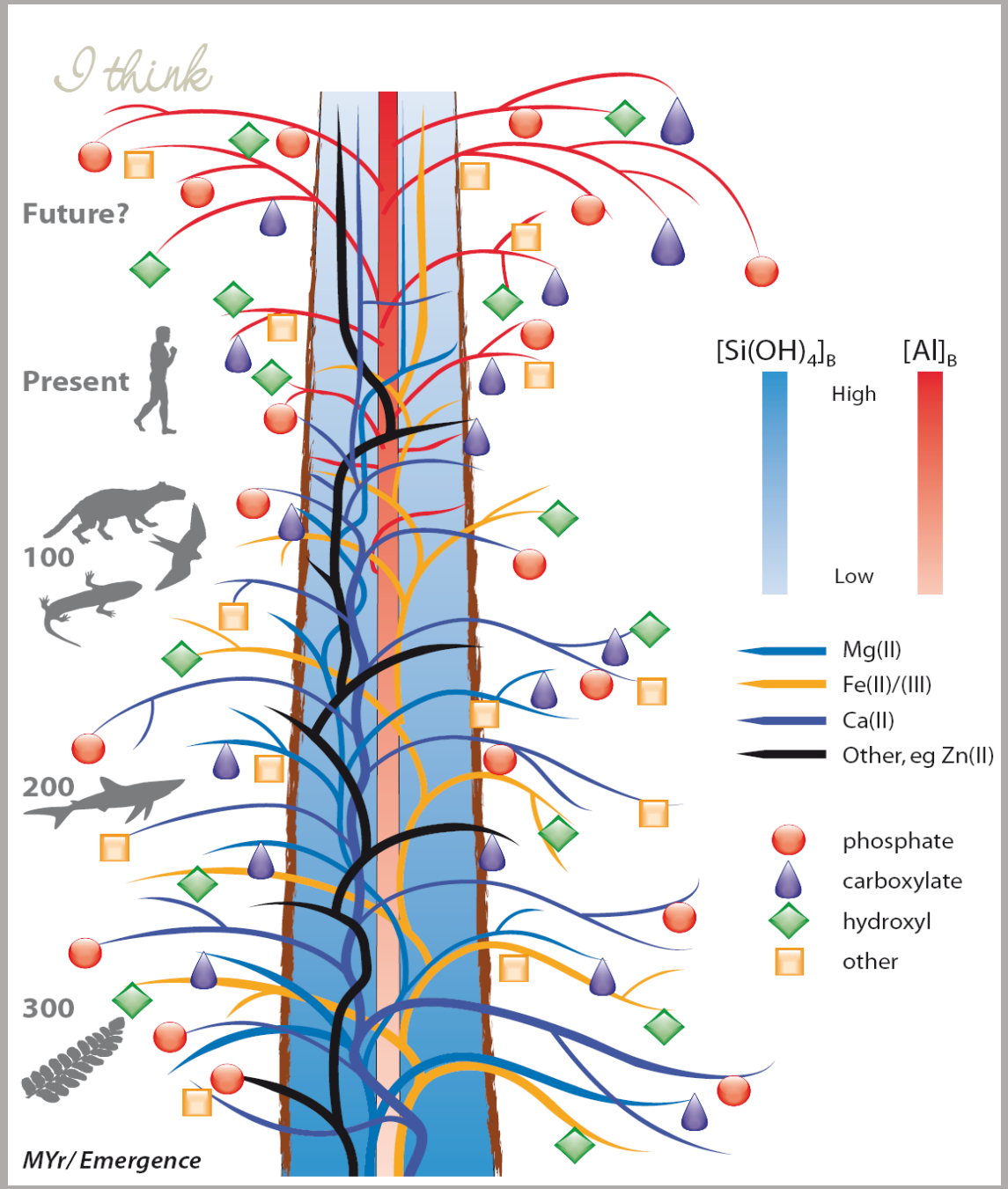
THE **ALUMINIUM** AGE

1889-Present Day

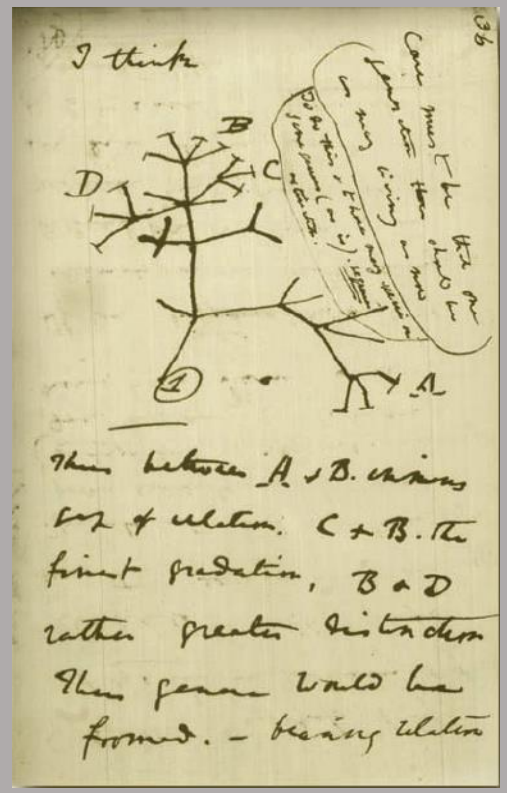


https://www.hippocraticpost.com/mens-health/the-aluminium-age/

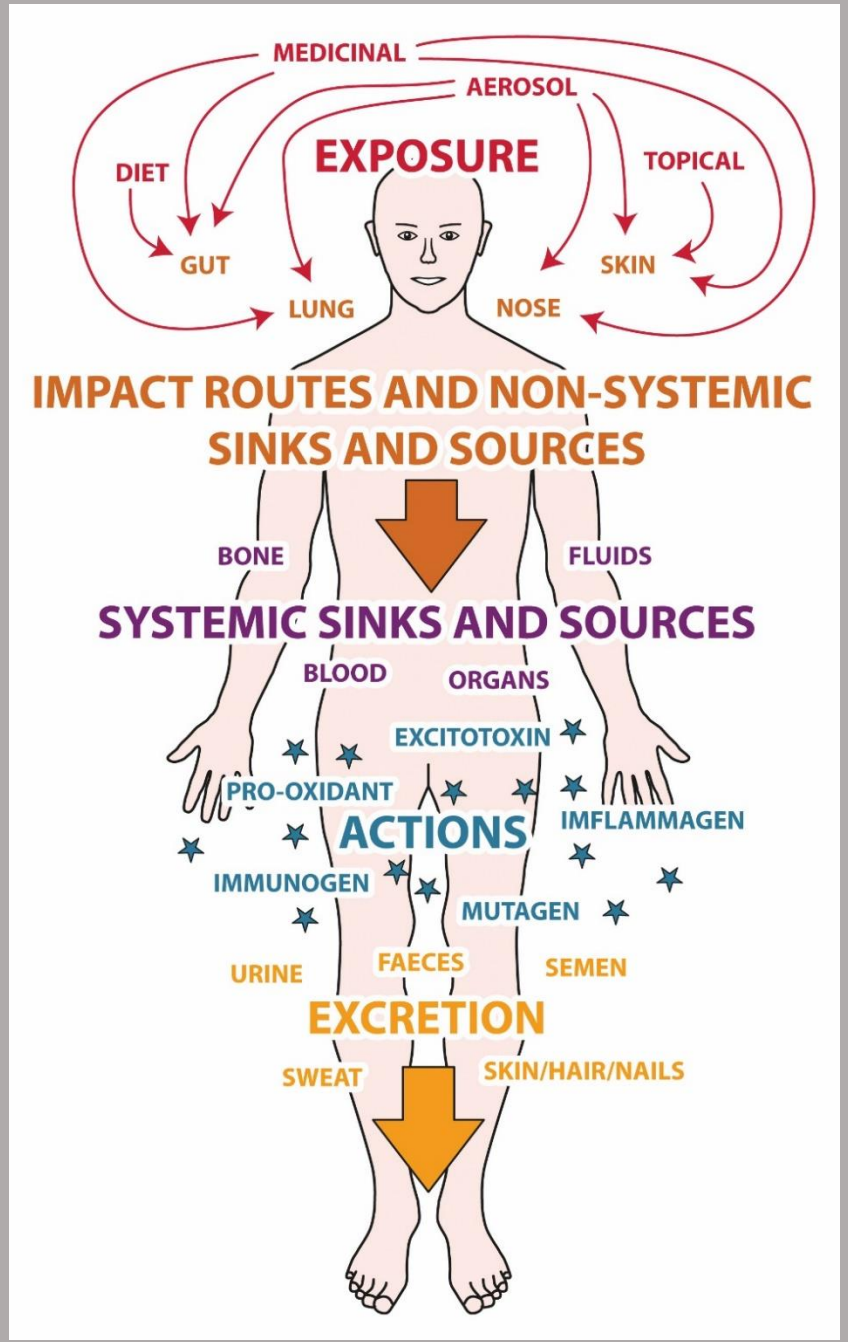
A Biochemical ‘Tree of Life’ for the Natural Selection of Aluminium

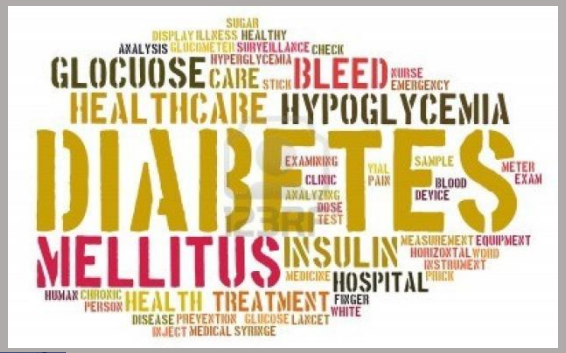


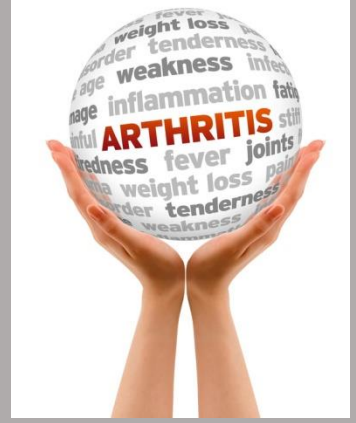
Exley C (2009) Darwin, natural selection and the biological essentiality of aluminium and silicon.
Trends in Biochemical Sciences 34, 589-593.

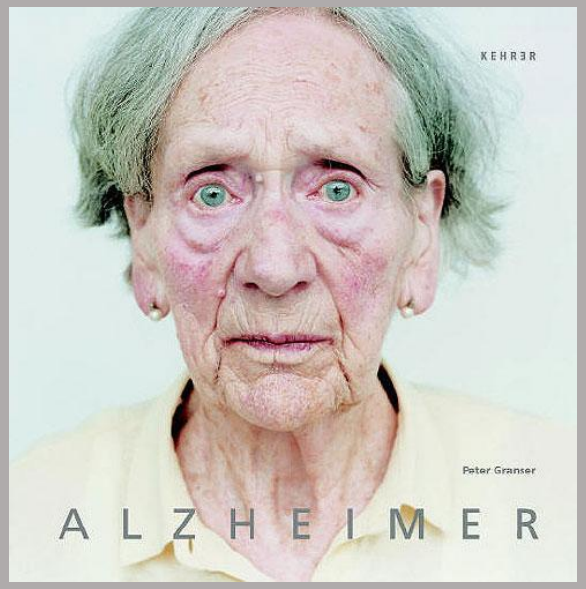


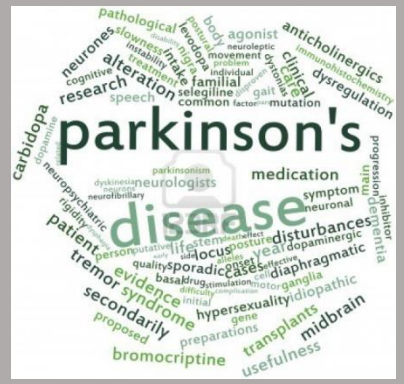
https://pubs.rsc.org/en/content/articlelanding/2013/em/c3em00374d#!divAbstract

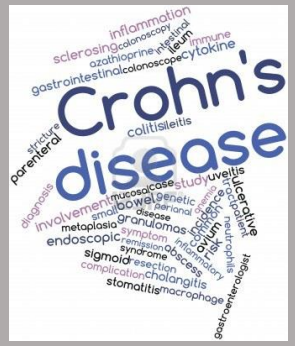








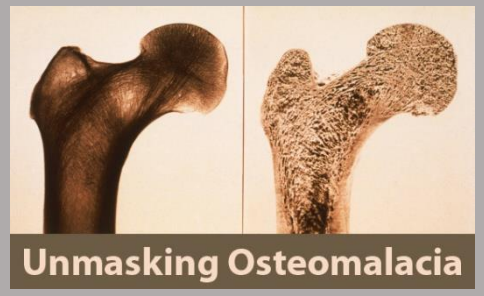




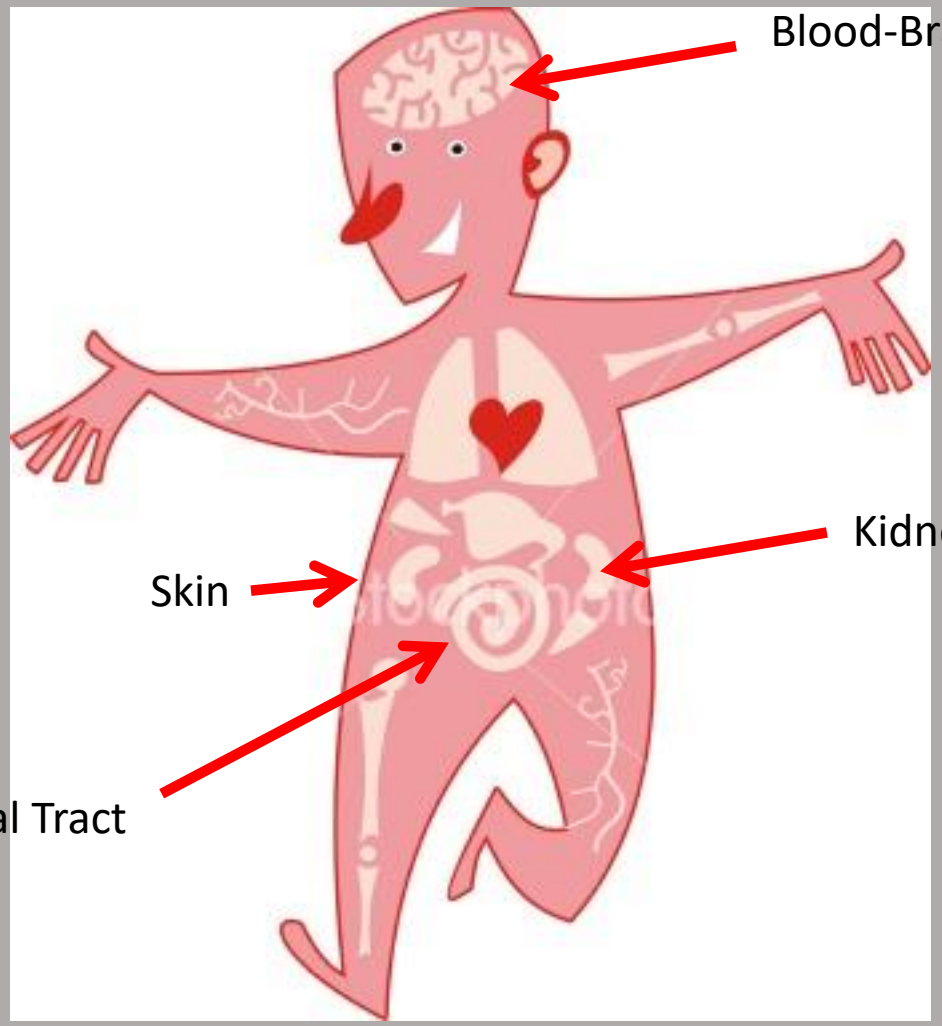
THE **ALUMINIUM** AGE?

https://www.hippocraticpost.com/mens-health/the-aluminium-age/

Awareness



The Infant (and Especially the Neonate) is a Special Case



Serum metallome in pregnant women and the relationship with congenital malformations of the central nervous system: a case-control study. Troisi et al. (2019)

https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-019-2636-5#Abs1

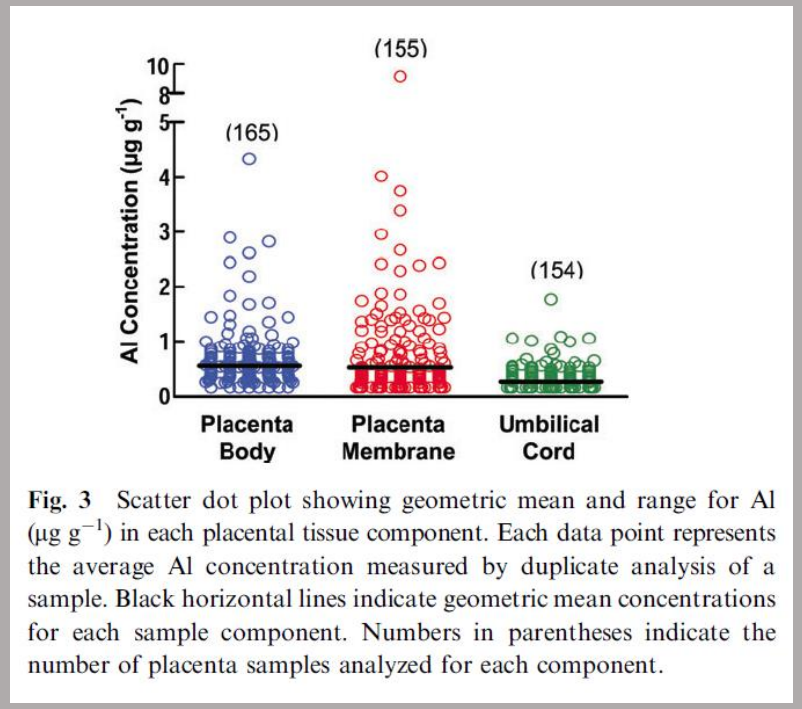
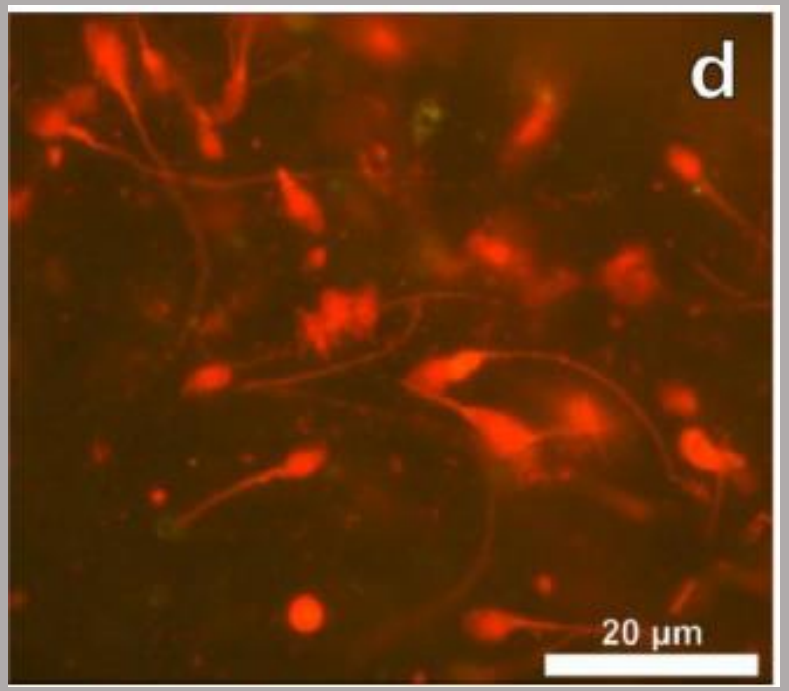


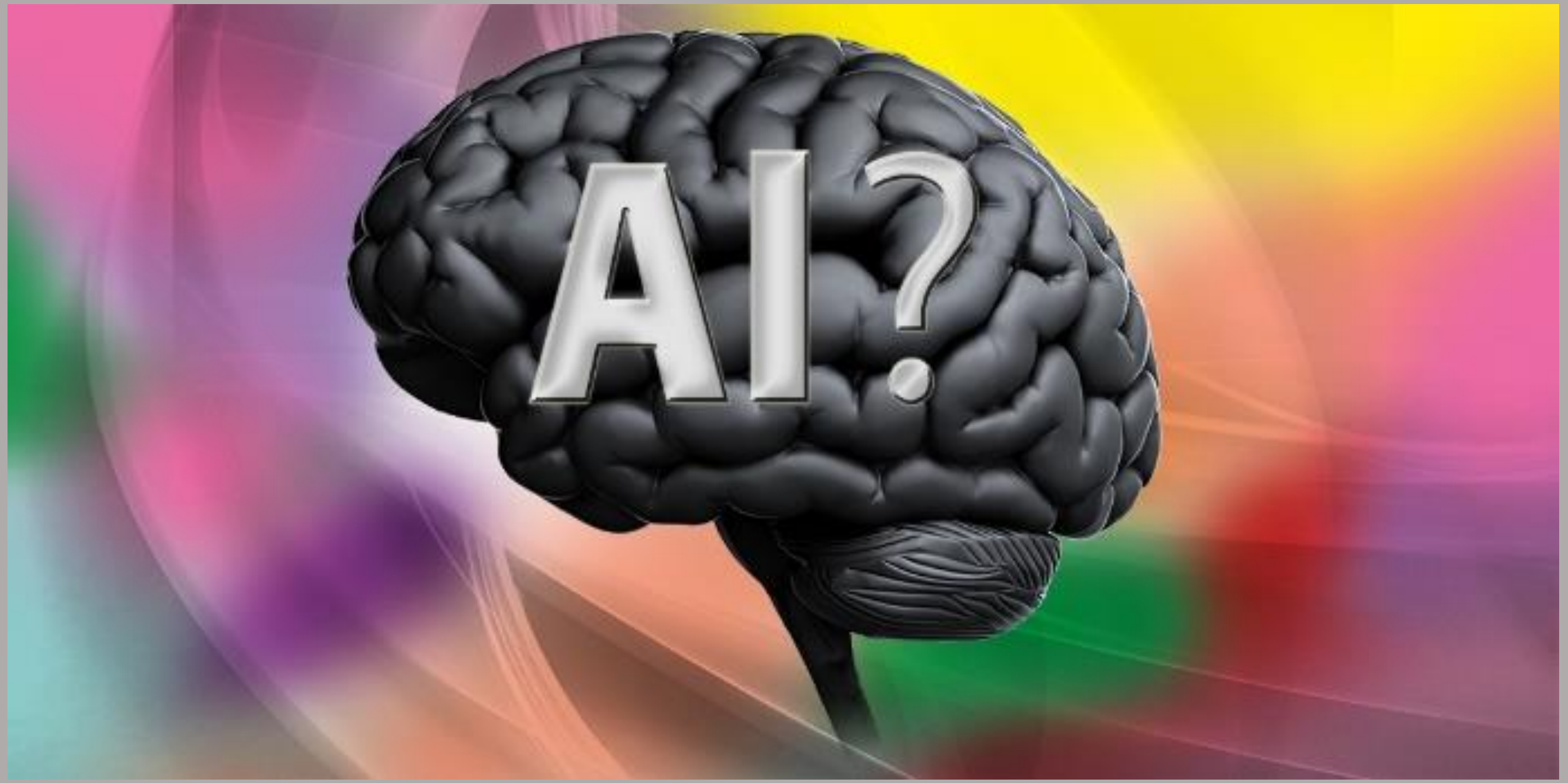
Fig. 3 Scatter dot plot showing geometric mean and range for Al (µg g^{-1}) in each placental tissue component. Each data point represents the average Al concentration measured by duplicate analysis of a sample. Black horizontal lines indicate geometric mean concentrations for each sample component. Numbers in parentheses indicate the number of placenta samples analyzed for each component.

Kruger PC, Schell LM, Stark AD and Parsons PJ (2010) Metallomics 2, 621-627.

Human exposure to aluminium begins at conception!



Klein JP, Mold M, Mery L, Cottier M and Exley C (2014) Reproductive Toxicology 50, 43-48.


AI?

JBIC Journal of Biological Inorganic Chemistry (2019) 24:1279–1282
https://doi.org/10.1007/s00775-019-01710-0

COMMENTARY

Aluminium in human brain tissue: how much is too much?

Christopher Exley[1] · Matthew J. Mold[1]

Received: 20 June 2019 / Accepted: 10 August 2019 / Published online: 29 August 2019

https://link.springer.com/article/10.1007%2Fs00775-019-01710-0

SCIENTIFIC REPORTS

nature research

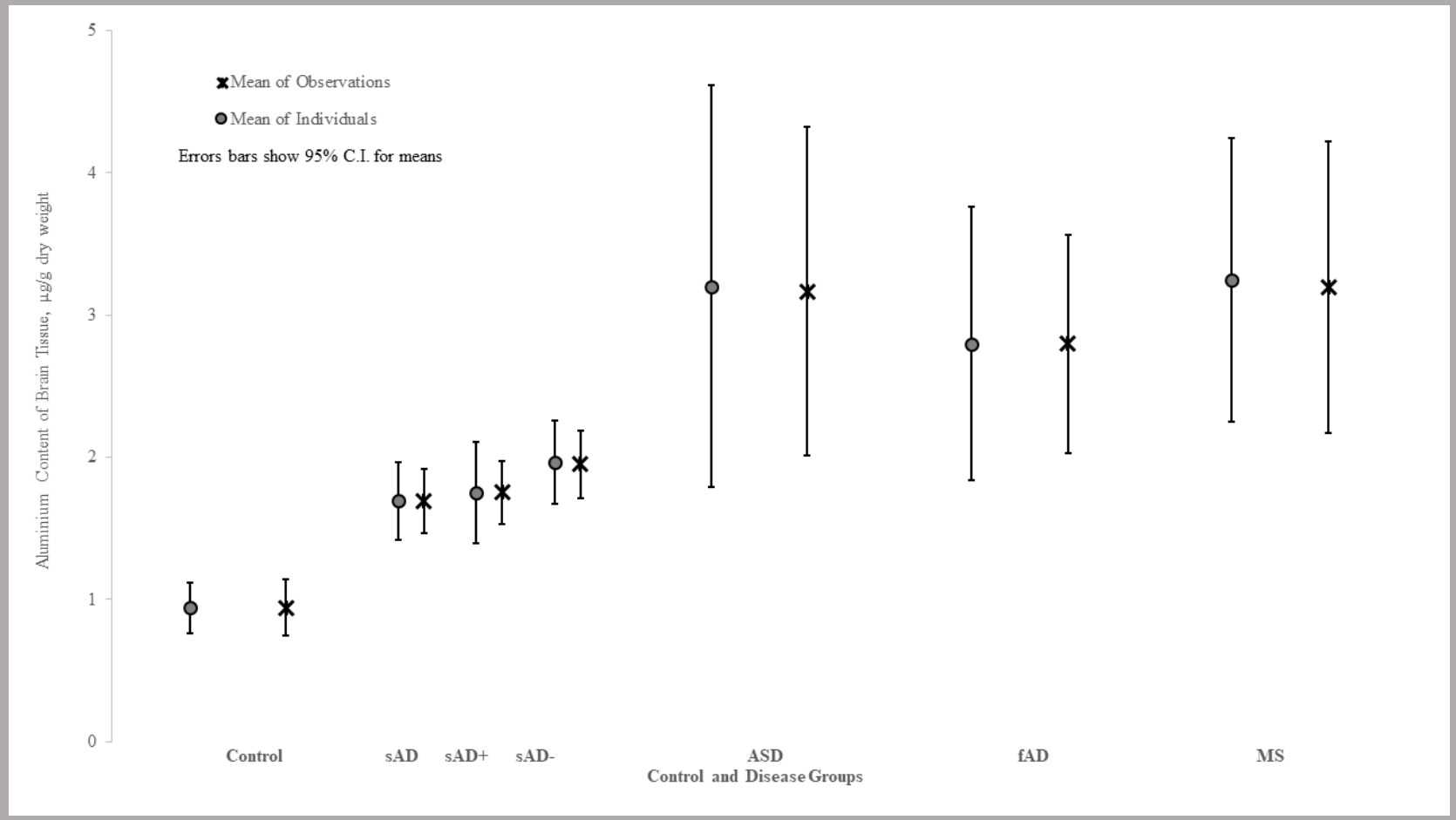
Check for updates

OPEN

Aluminium in human brain tissue from donors without neurodegenerative disease: A comparison with Alzheimer's disease, multiple sclerosis and autism

Christopher Exley[1] ✉ & Elizabeth Clarkson[2]

https://www.nature.com/articles/s41598-020-64734-6



The aluminium content of brain tissue in the control group was significantly lower than sporadic Alzheimer's disease (sAD) (**P=0.0006**), familial (London Cohort) Alzheimer's disease (fAD) (**P=0.0020**), autism (ASD) (**P=0.0123**) and multiple sclerosis MS (**P<0.0001**).

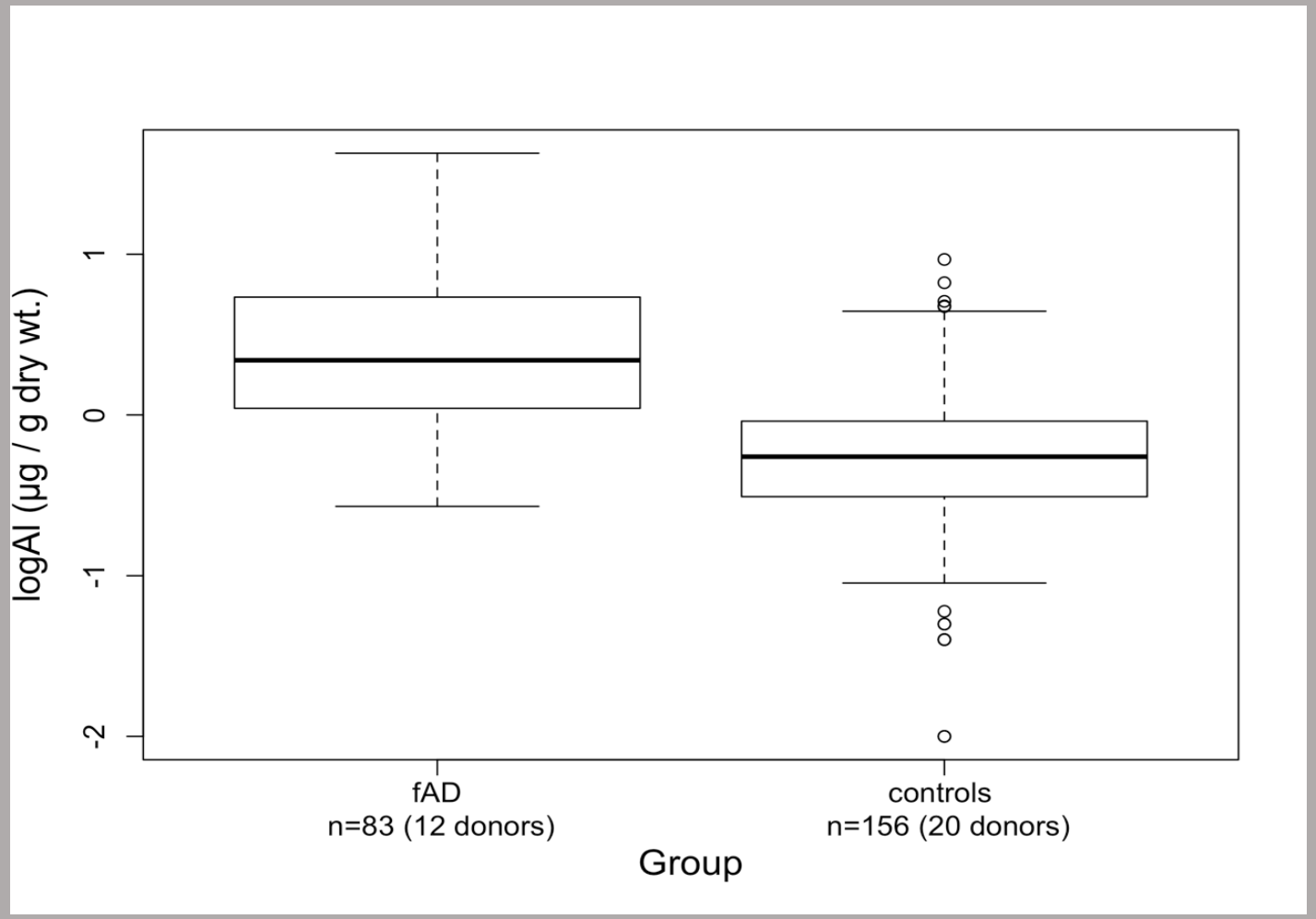
Journal of Alzheimer's Disease 73 (2020) 1627–1635
DOI 10.3233/JAD-191140
IOS Press

Aluminum and Amyloid-β in Familial Alzheimer's Disease

Matthew Mold[a], Caroline Linhart[b], Johana Gómez-Ramírez[c], Andrés Villegas-Lanau[c] and Christopher Exley[a,*]

[a]*The Birchall Centre, Lennard-Jones Laboratories, Keele University, Staffordshire, United Kingdom*
[b]*Institute of Pharmacy/Pharmacognosy, University of Innsbruck, Innsbruck, Austria*
[c]*Grupo de Neurociencias de Antioquia, Sede de Investigación Universitaria SIU, Medellín, Colombia*

https://content.iospress.com/articles/journal-of-alzheimers-disease/jad191140



The aluminum content (median and IQR) of fAD (Colombian Cohort) brain tissues (2.19; 1.10–5.41) was significantly higher (***p*<0.001**) than control tissues (0.60; 0.35–0.98).

Exposure and Health
https://doi.org/10.1007/s12403-020-00346-9

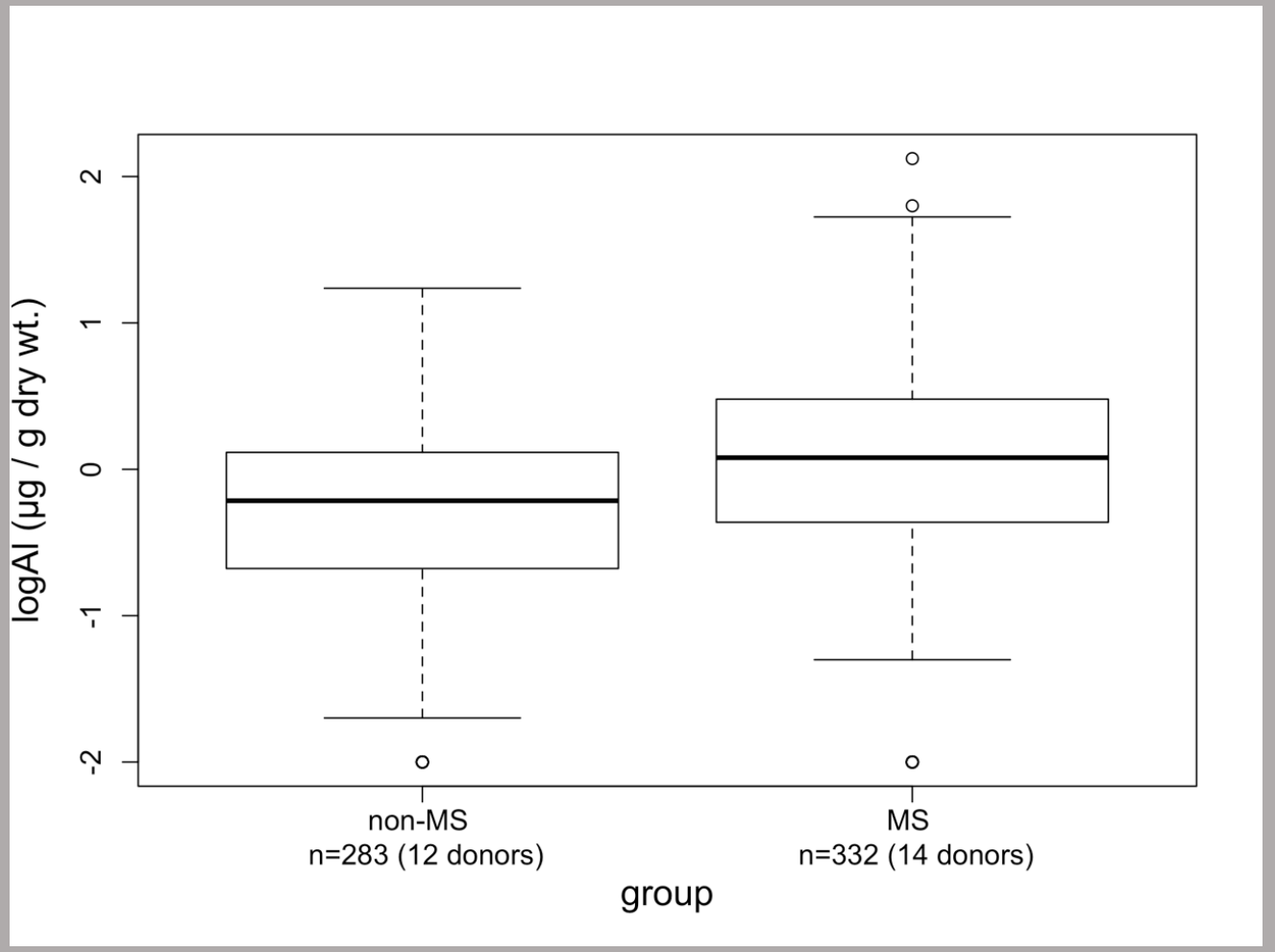
ORIGINAL PAPER

Aluminium in Brain Tissue in Non-neurodegenerative/ Non-neurodevelopmental Disease: A Comparison with Multiple Sclerosis

C. Linhart[1] · D. Davidson[2] · S. Pathmanathan[2] · T. Kamaladas[2] · C. Exley[3]

Received: 5 October 2019 / Revised: 7 February 2020 / Accepted: 15 February 2020

https://link.springer.com/article/10.1007%2Fs12403-020-00346-9



The aluminium content across all lobes were significantly higher in MS donors (mixed effect model, n(samples)= 615 , N(donors) = 26, **p = 0.004**) than non-MS donors.

How much aluminium in brain tissue is too much?
THIS IS TOO MUCH!

So, there is too much aluminium in human brain tissue in neurodegenerative and neurodevelopmental disease and this is what it looks like?

Journal of Alzheimer's Disease 54 (2016) 1333–1338
DOI 10.3233/JAD-160648
IOS Press

The Identification of Aluminum in Human Brain Tissue Using Lumogallion and Fluorescence Microscopy

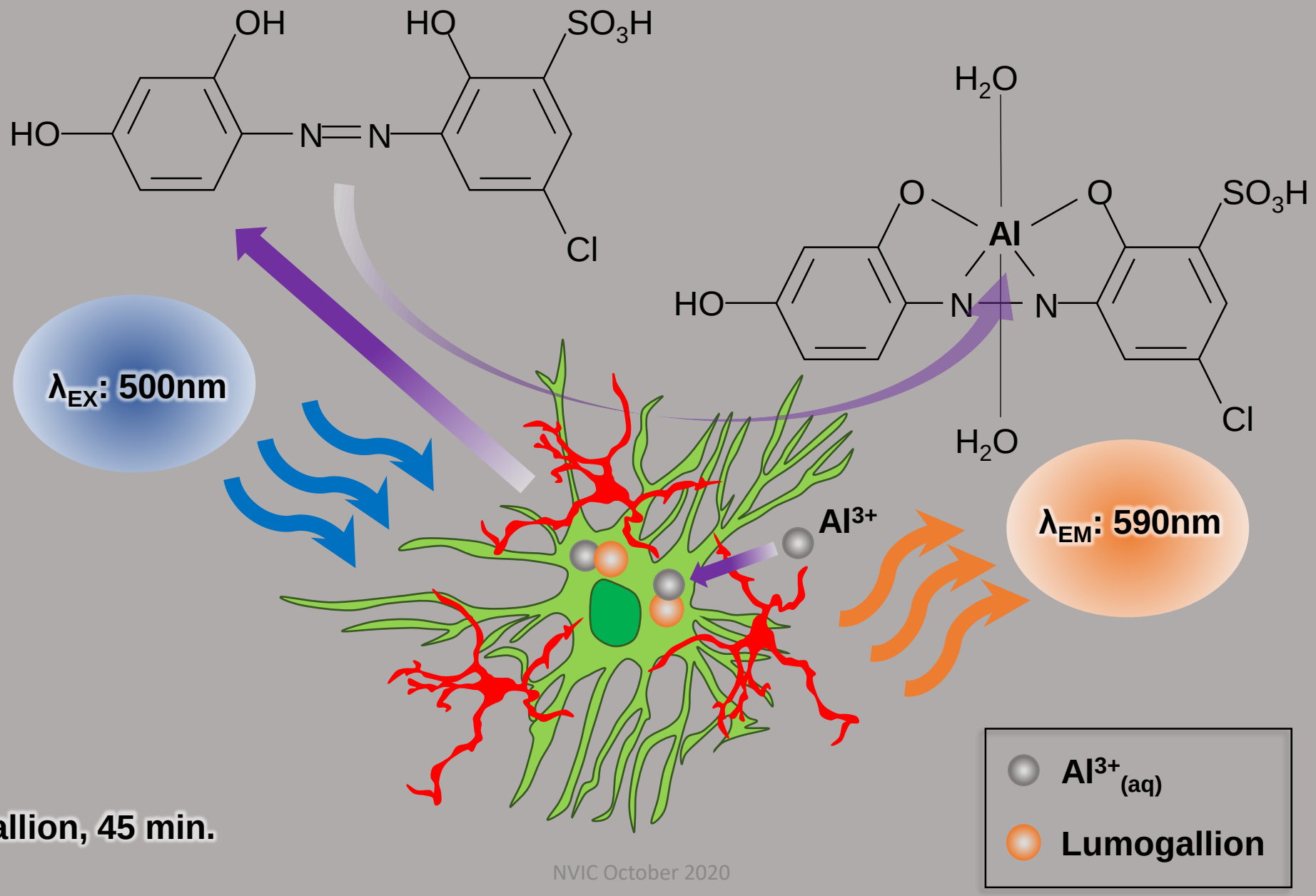
Ambreen Mirza[a], Andrew King[b,c], Claire Troakes[c] and Christopher Exley[a,*]
[a]*The Birchall Centre, Lennard-Jones Laboratories, Keele University, Staffordshire, UK*
[b]*Department of Clinical Neuropathology, King's College Hospital, London, UK*
[c]*MRC London Neurodegenerative Diseases Brain Bank, Institute of Psychiatry, Psychology and Neuroscience, King's College, London, UK*

Accepted 4 July 2016

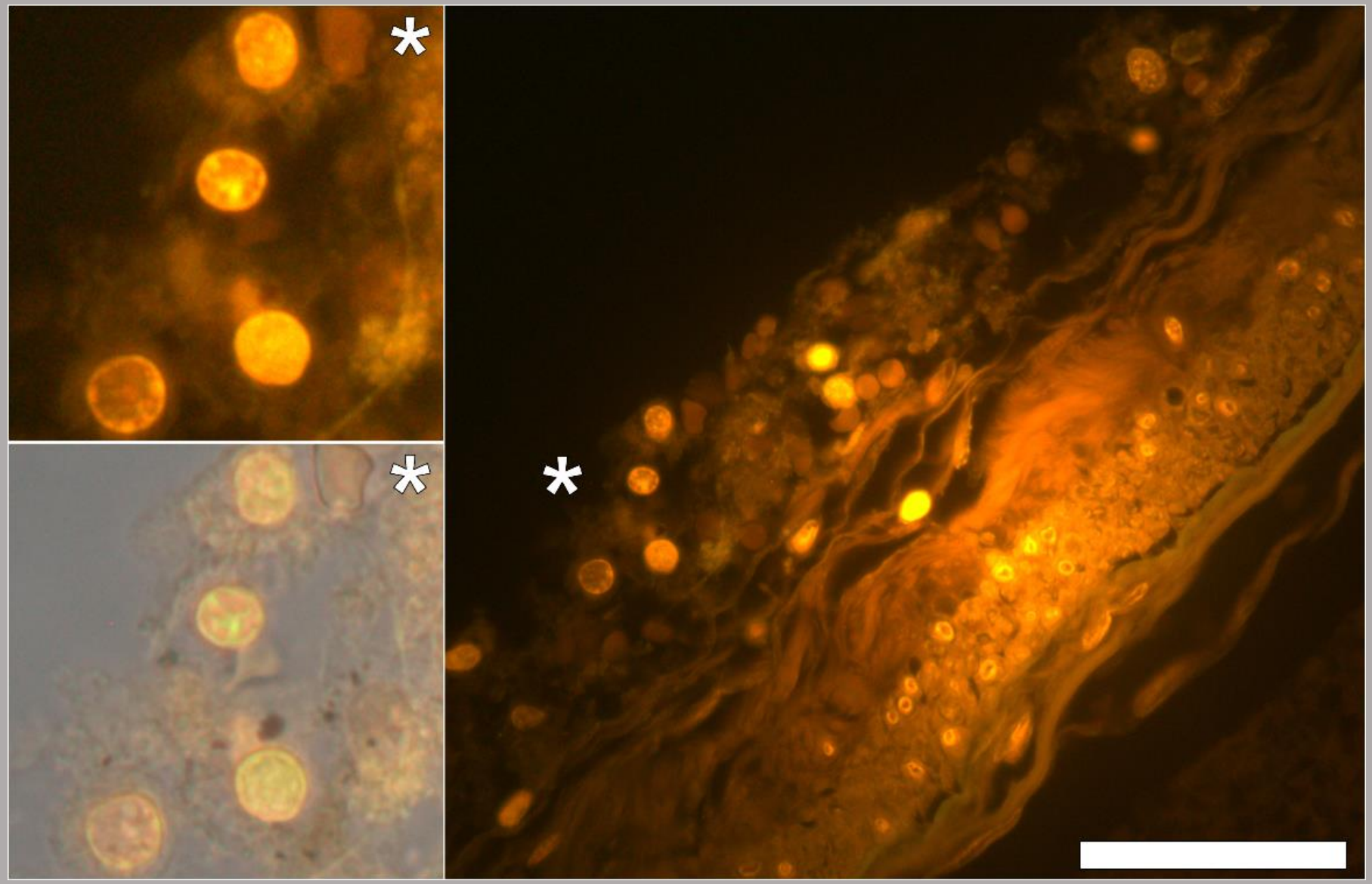
Abstract. Aluminum in human brain tissue is implicated in the etiologies of neurodegenerative diseases including Alzheimer's disease. While methods for the accurate and precise measurement of aluminum in human brain tissue are widely acknowledged, the same cannot be said for the visualization of aluminum. Herein we have used transversely-heated graphite furnace atomic absorption spectrometry to measure aluminum in the brain of a donor with Alzheimer's disease, and we have developed and validated fluorescence microscopy and the fluor lumogallion to show the presence of aluminum in the same tissue. Aluminum is observed as characteristic orange fluorescence that is neither reproduced by other metals nor explained by autofluorescence. This new and relatively simple method to visualize aluminum in human brain tissue should enable more rigorous testing of the aluminum hypothesis of Alzheimer's disease (and other neurological conditions) in the future.

Keywords: Aluminum, Alzheimer's disease, brain tissue, fluorescence microscopy, lumogallion, transversely heated graphite furnace atomic absorption spectrometry

https://content.iospress.com/articles/journal-of-alzheimers-disease/jad160648

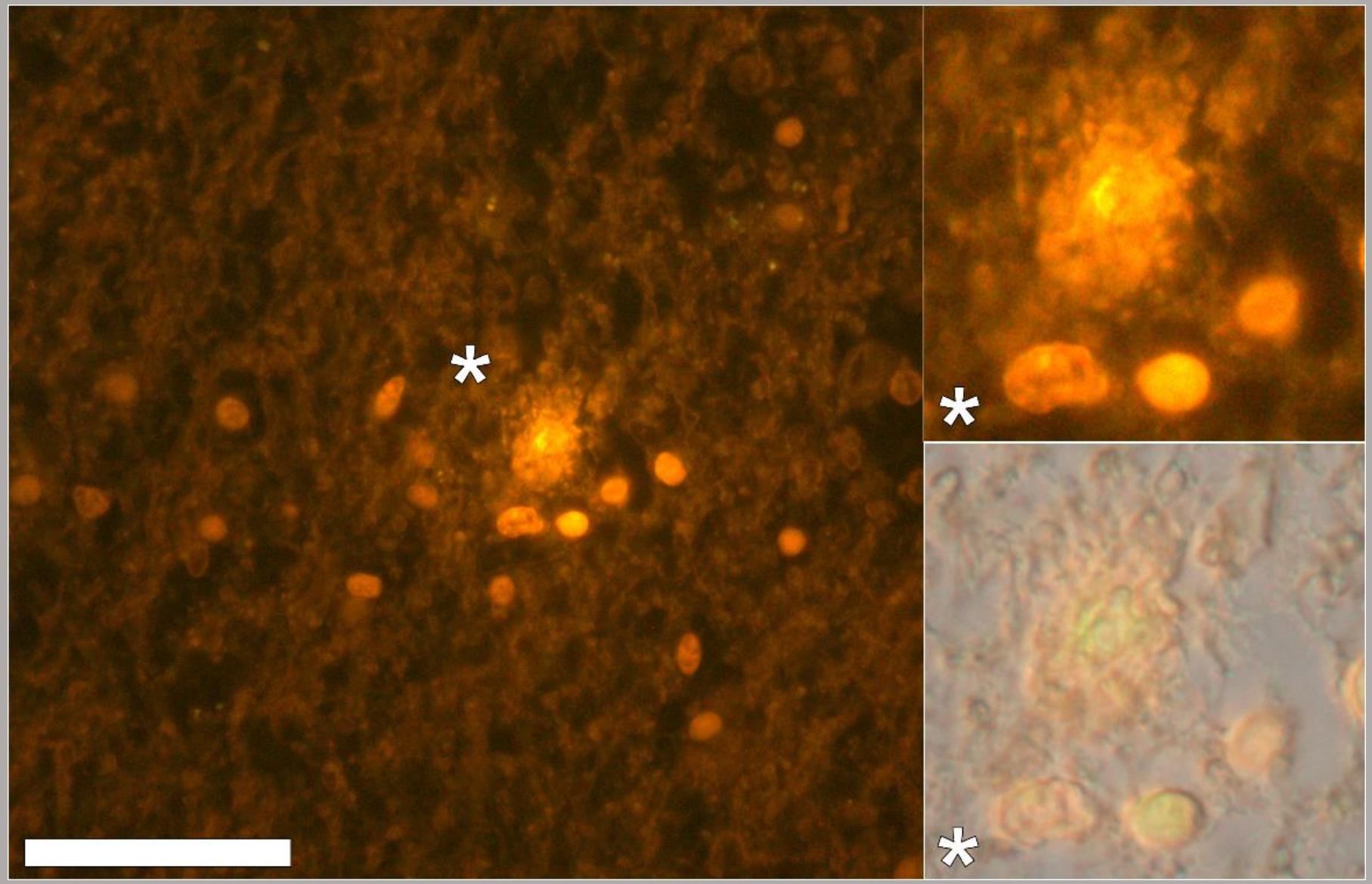


1mM lumogallion, 45 min.



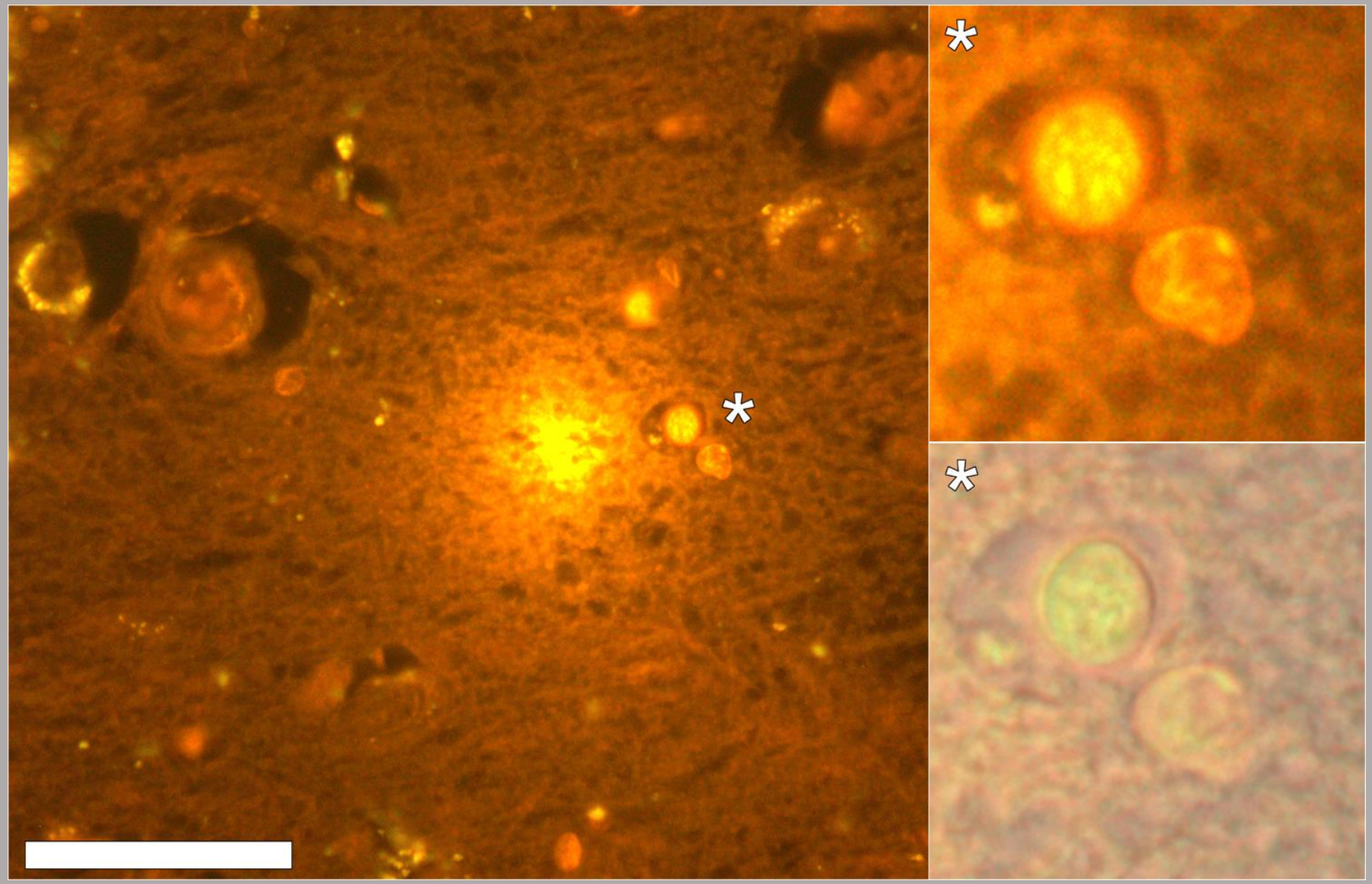
Intracellular aluminium in lymphocytes in the meninges of a 50-year-old male donor, diagnosed with autism.

www.sciencedirect.com/science/article/pii/S0946672X17308763?via%3Dihub

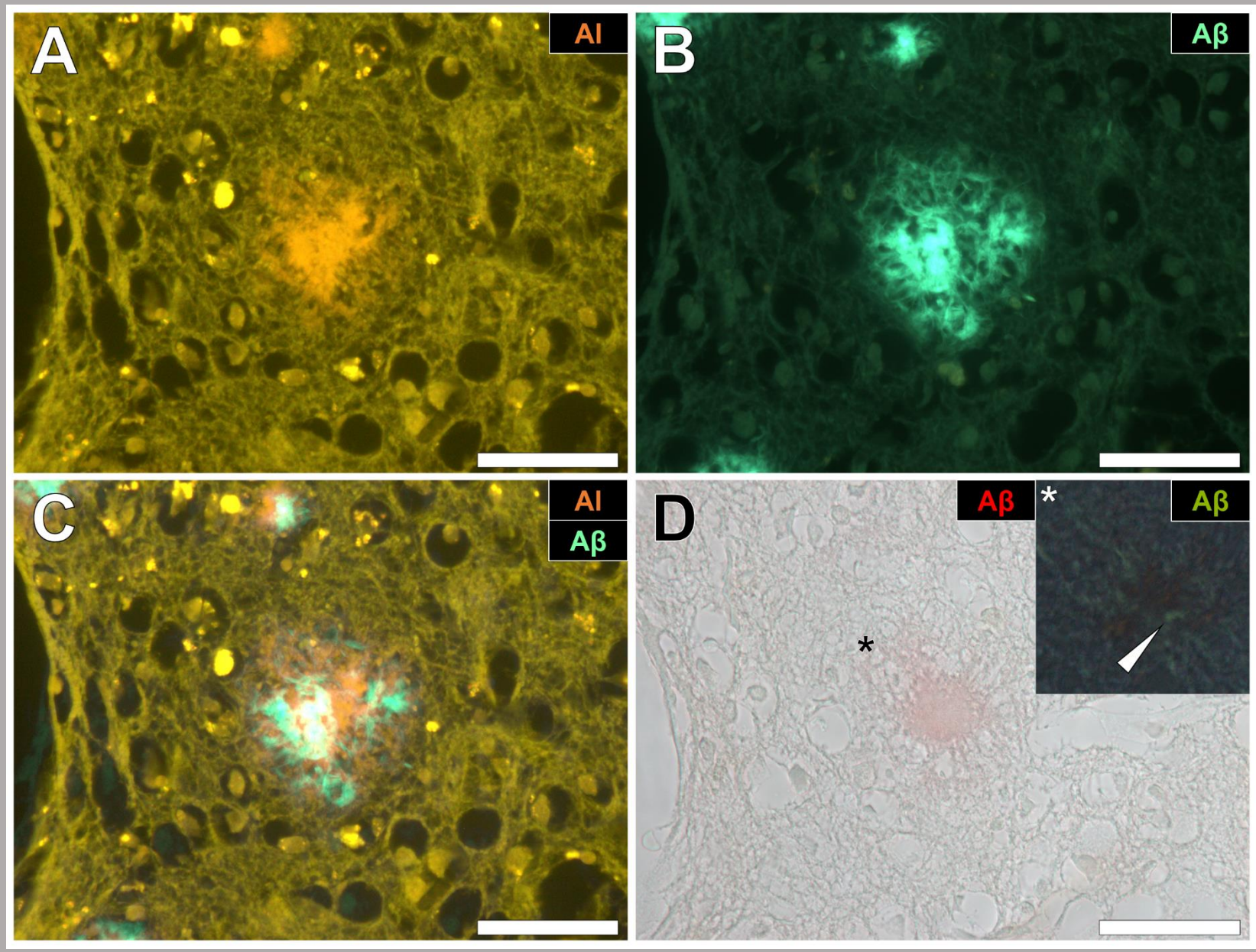


Intracellular aluminium in glial cells in the hippocampus of a 15-year-old male donor, diagnosed with autism.

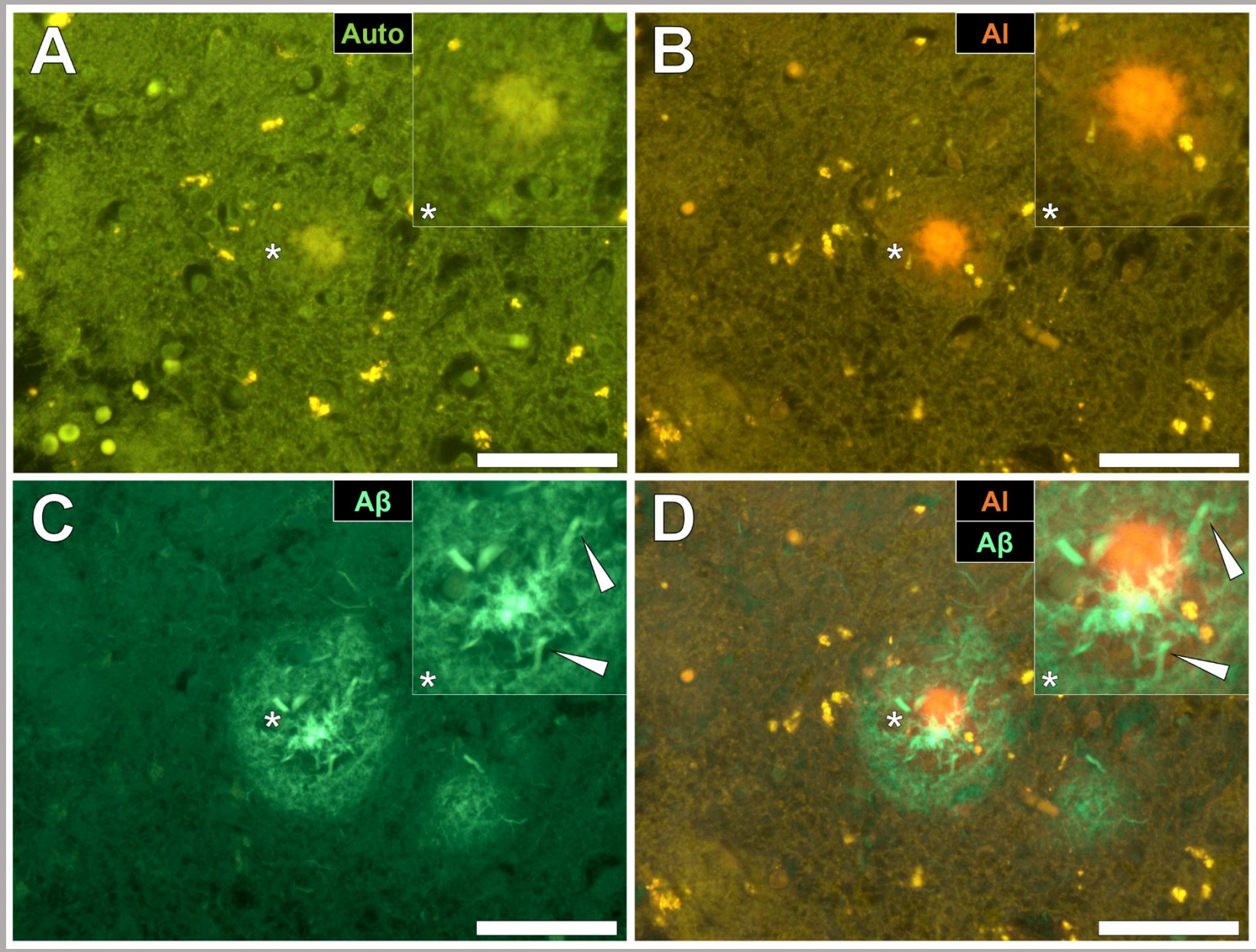
www.sciencedirect.com/science/article/pii/S0946672X17308763?via%3Dihub



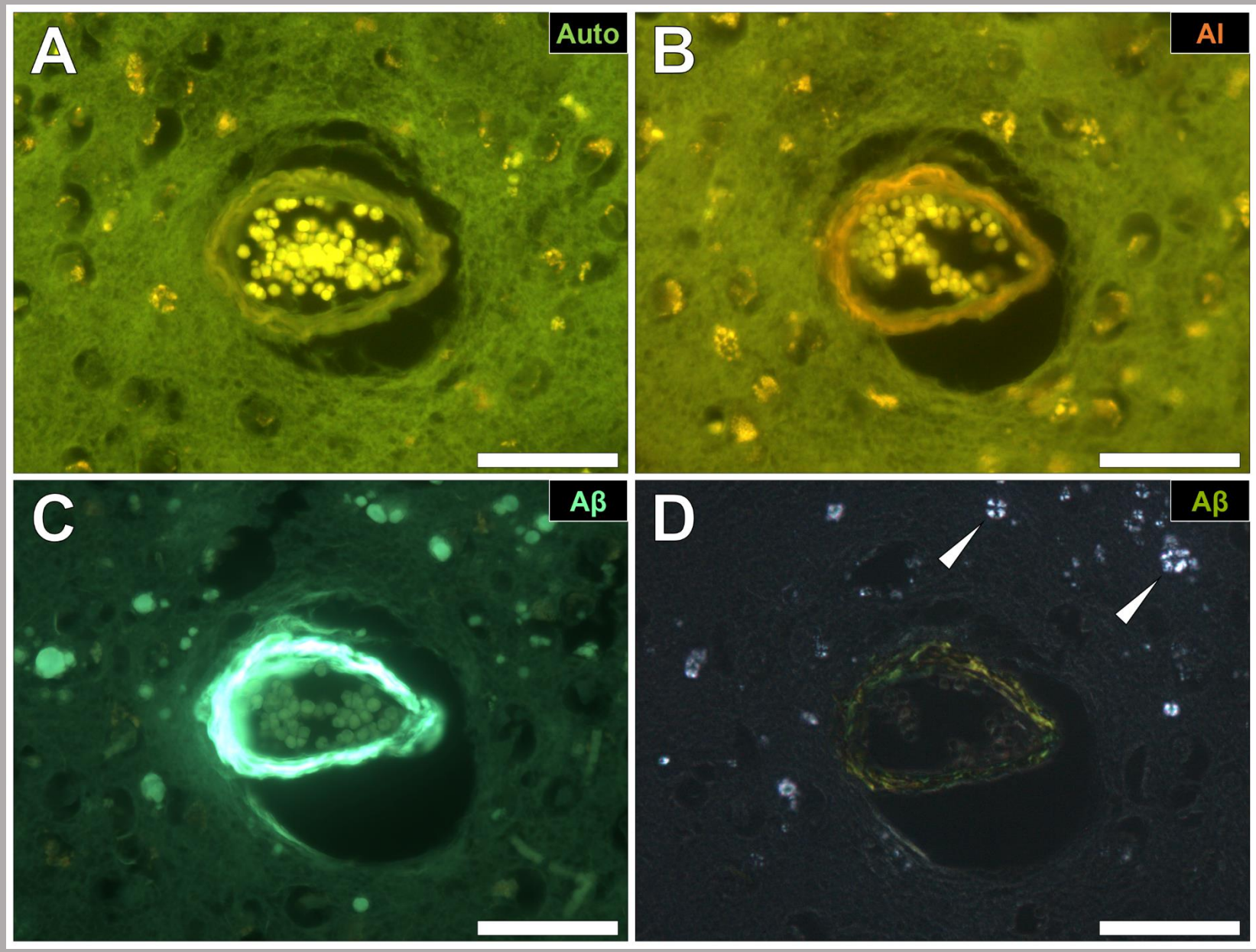
Aluminium-loaded glial cells in close proximity to aluminium-rich extracellular debris in the frontal cortex of a male donor, diagnosed with epilepsy. www.mdpi.com/1660-4601/16/12/2129



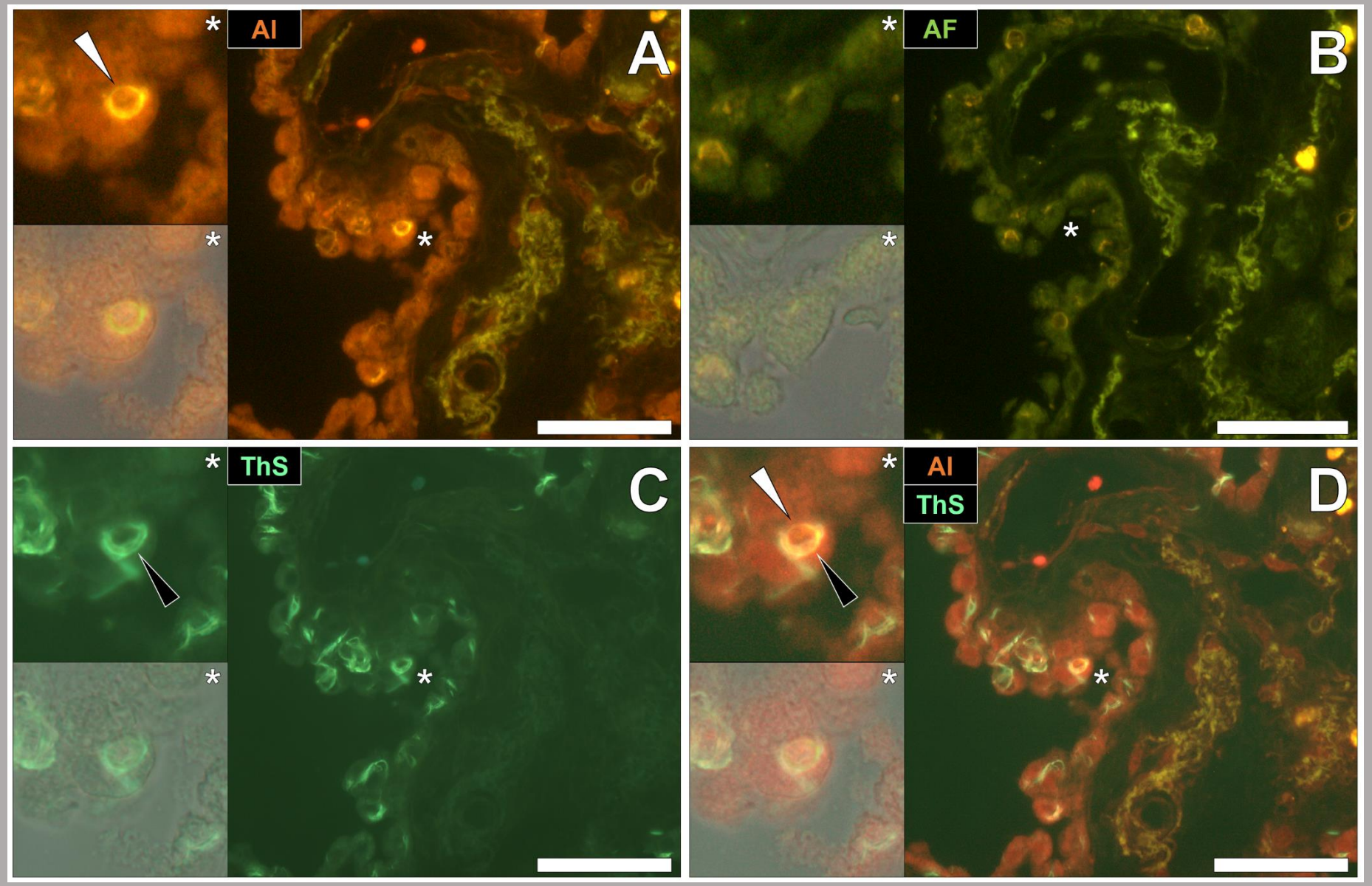
Aluminium and amyloid-β co-localised in a senile plaque in the brain of a donor with familial Alzheimer's disease (PSEN1-E280A). https://content.iospress.com/articles/journal-of-alzheimers-disease/jad191140



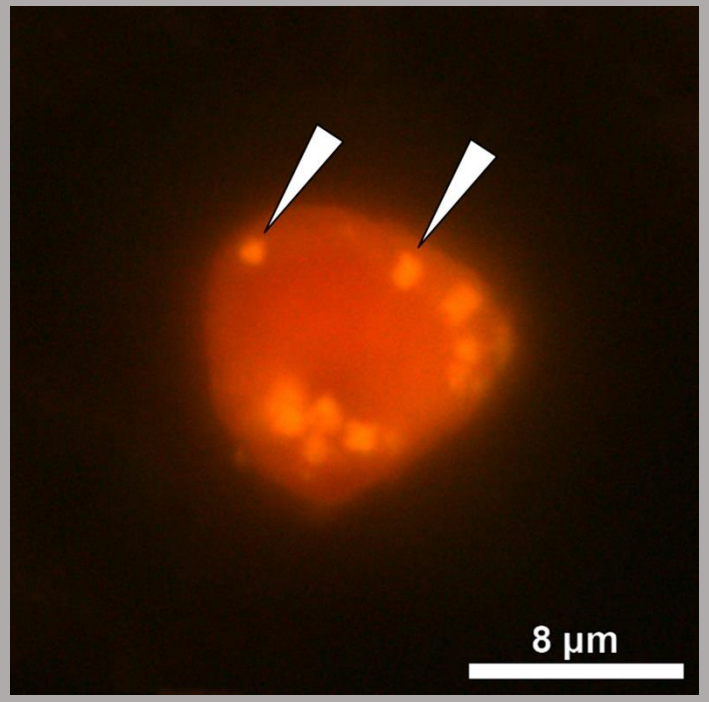
Aluminium and thread-like amyloid-β co-localised in a senile plaque in the brain of a donor with familial Alzheimer's disease (PSEN1-E280A). https://content.iospress.com/articles/journal-of-alzheimers-disease/jad191140



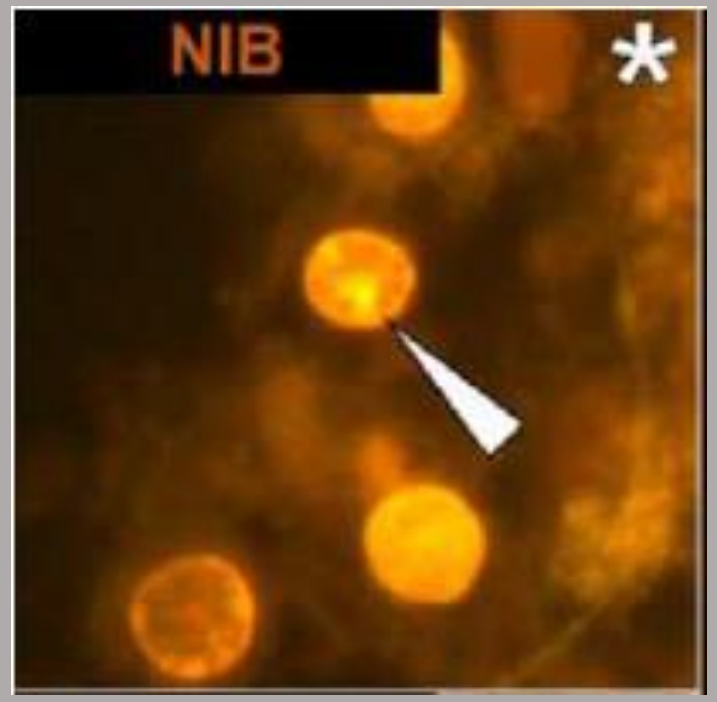
Aluminium and amyloid-β co-localised in a blood vessel in the brain of a donor with familial Alzheimer's disease (PSEN1-E280A). https://content.iospress.com/articles/journal-of-alzheimers-disease/jad191140



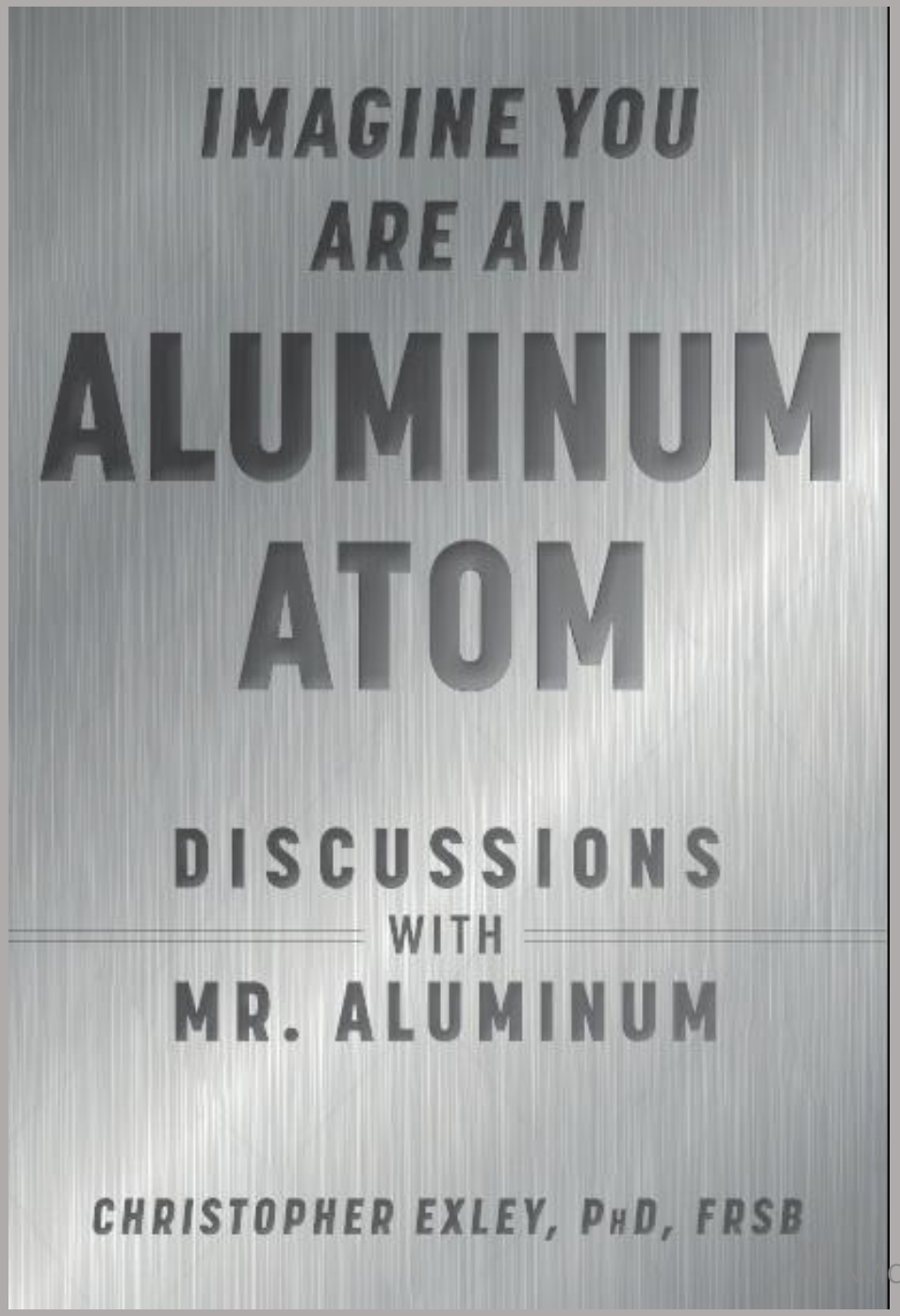
Aluminium and Biondi ring-like tangles of tau co-localised in epithelial cells lining the choroid plexus (hippocampus) of a donor with Parkinson's disease. (In the press.)



This is what aluminium looks like in a THP-1 cell following exposure to aluminium adjuvant.



This is what aluminium looks like In a lymphocyte crossing the meninges in autism brain tissue.



https://www.simonandschuster.com/books/Imagine-You-Are-An-Aluminum-Atom/Christopher-Exley/9781510762534