21 March 2023
Cuban Academy of Sciences
Havana, Cuba

Opening Doors Worldwide through Science

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Bloomberg School of Public Health
Baltimore, Maryland

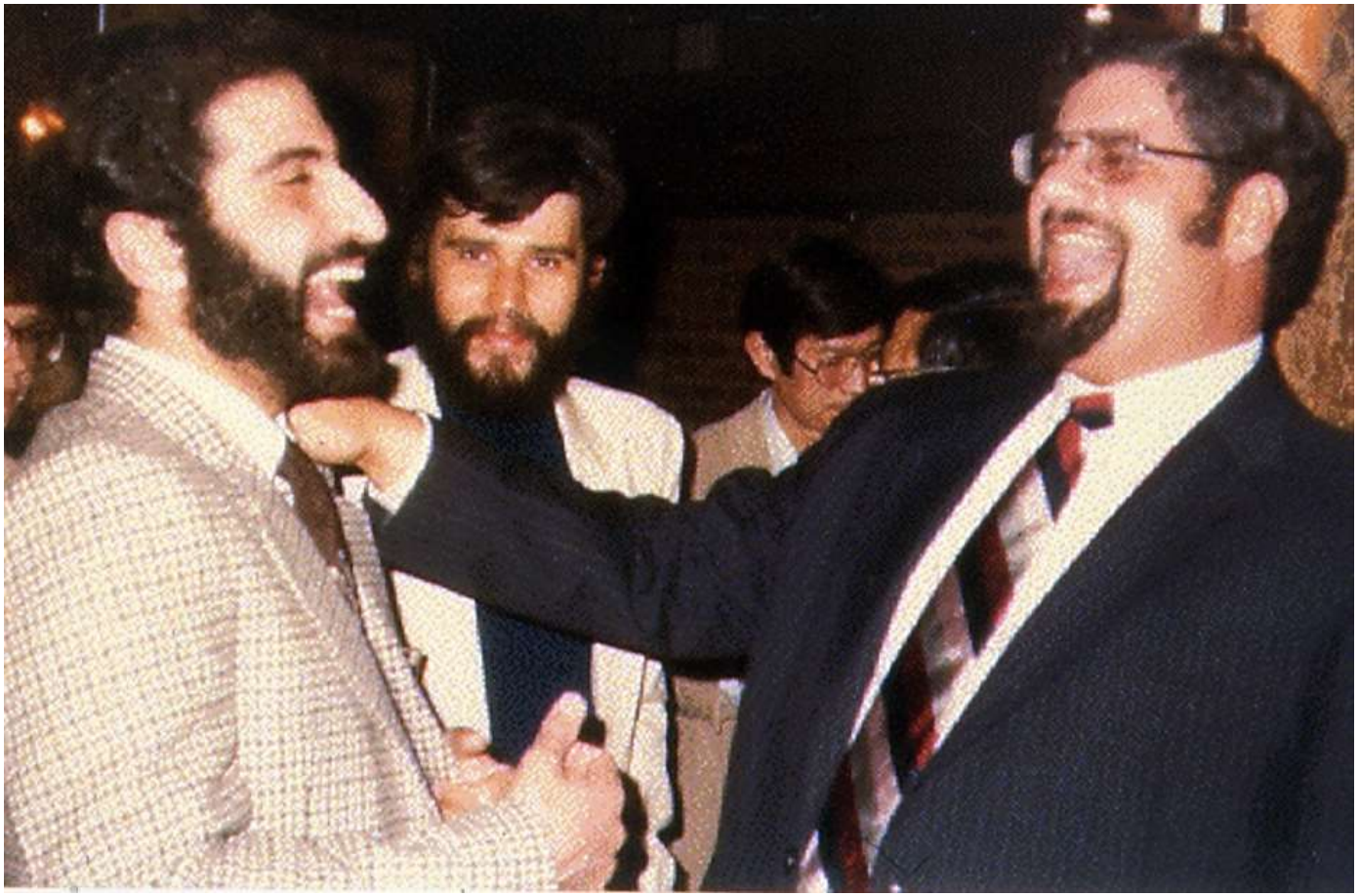
World Views of United States Science

	U.S. in general		U.S. science & technol	
Country	Favorable	Unfavorable	Favorable	Unfavorable
Morocco	11%	88	90	08
Saudi Arabia	04	94	48	51
Jordan	15	78	83	13
Lebanon	20	69	52	46
UAE	14	73	84	12

From: Arab Views toward America, Zogby 2004

en route to Johns Hopkins, 1970

Cuatrecasas Lab, 1974

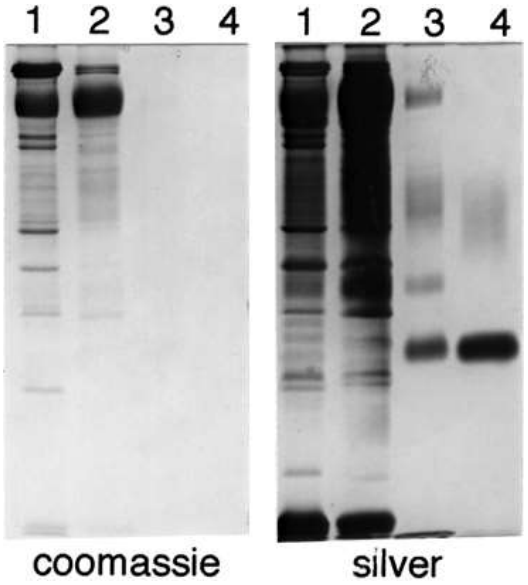


Naji and Marvin

Discovery of Aquaporin-1

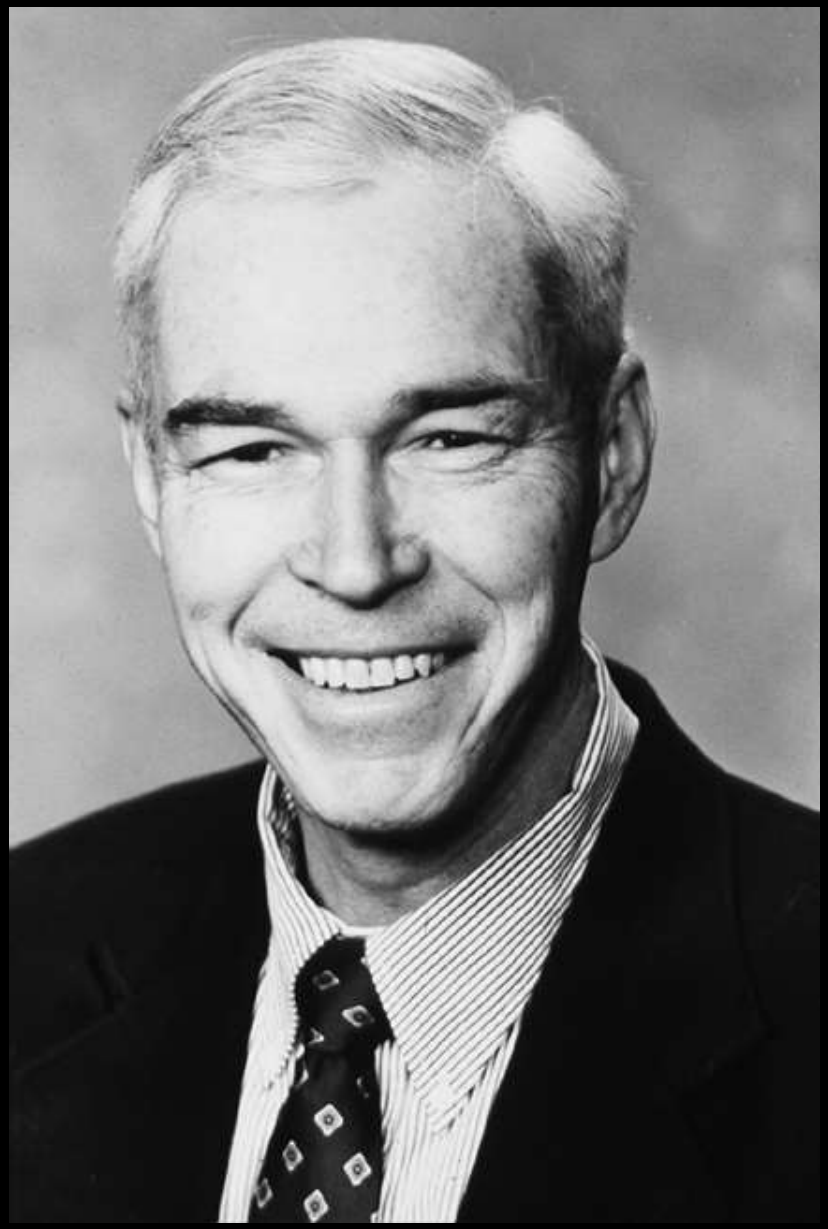
A serendipitous observation

Simple purification
- Atypical staining
- Insoluble in N-lauroylsarc.



200,000 copies per red cell
Channel-like homotetramer
Protein sequence 1-35 aa

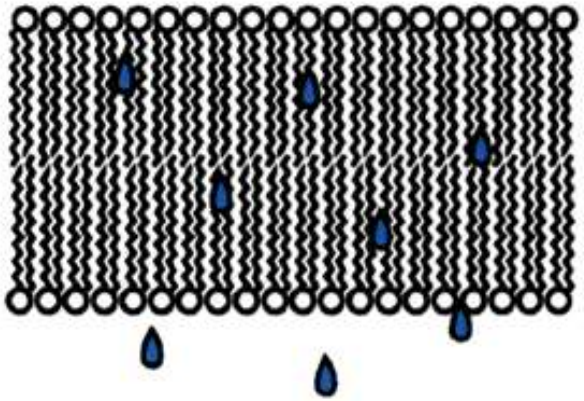
Denker *et al., J Biol Chem,* 1988
Smith & Agre, *J Biol Chem,* 1991



John C. Parker, M.D. 1935-1993

Transmembrane water permeability—Current view

Bilayer Diffusion



All biological membranes

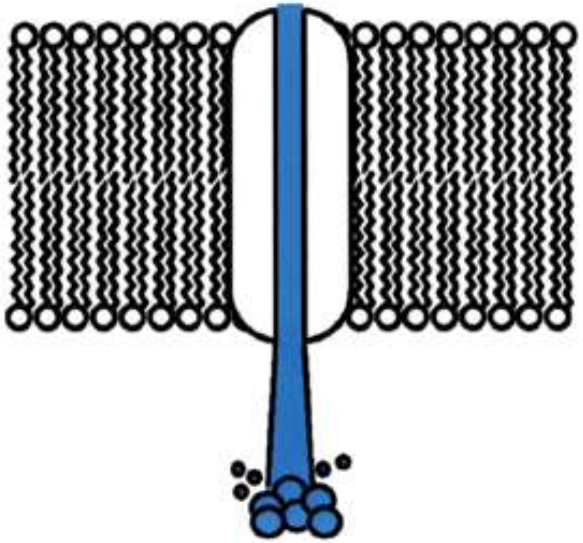
Low capacity

Bi-directional

No known inhibitors

E_a ~10 kcal/mol

Aquaporin Water Channels



Renal tubules, secretory glands, red cells

High capacity for H_2O, not H_3O^+

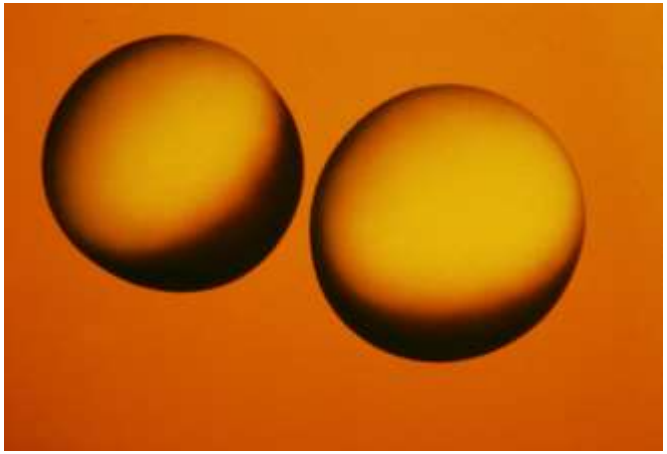
Directed by osmotic gradients

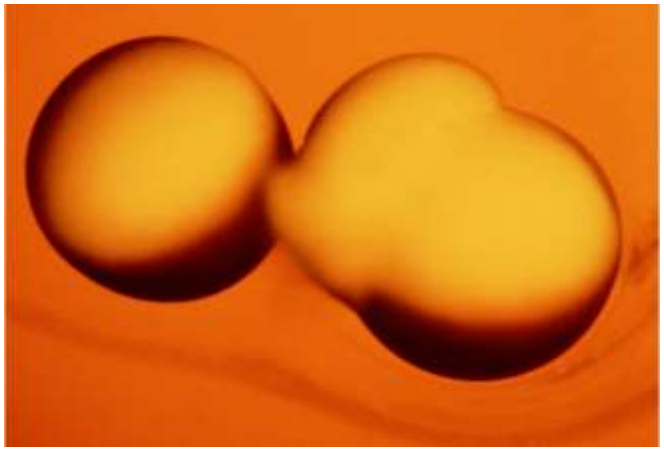
Reversibly inhibited by Hg^{++}

E_a <5 kcal/mol

Discovery of Aquaporin-1

Functional expression (with Wm. Guggino, JHMI)





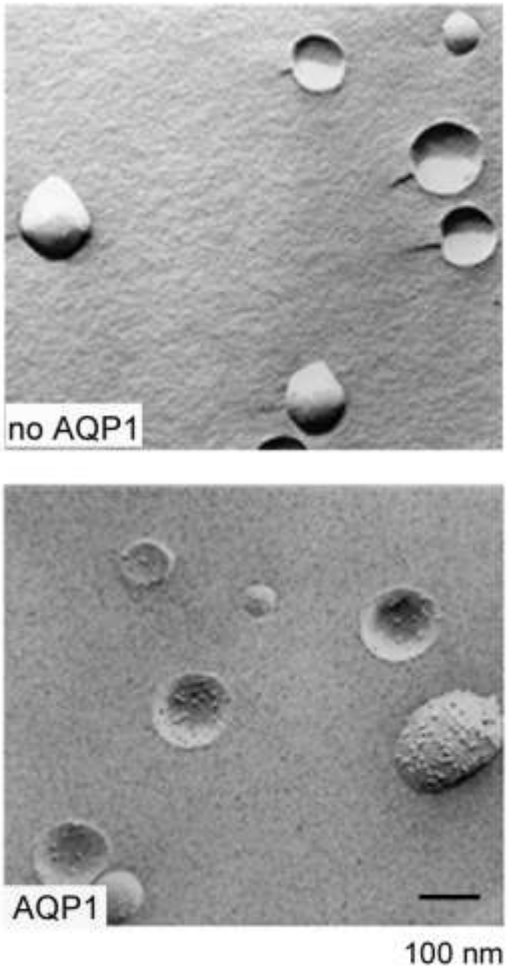
Hypo-osmolar swelling
Hg^{++} inhibited, no currents

Preston *et al., Science* 1992

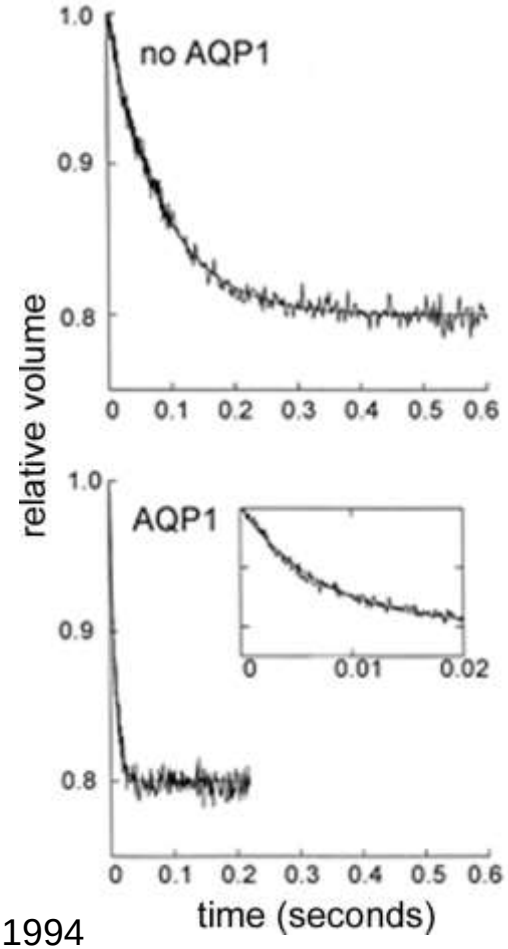
Verification of AQP1 function

Functional reconstitution

Reconstituted membranes



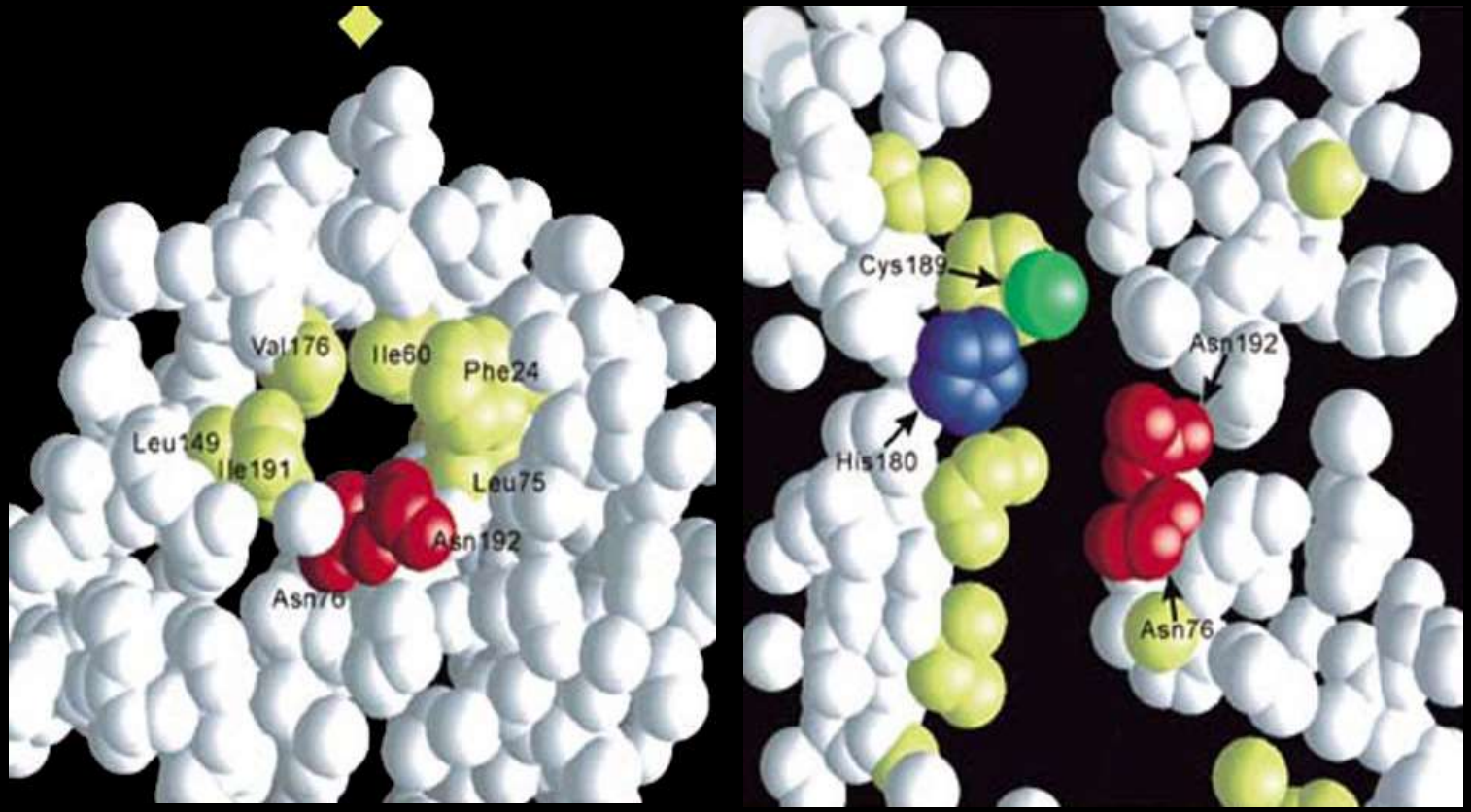
Stopped-flow water permeability



Zeidel *et al., Biochemistry* 1992, 1994

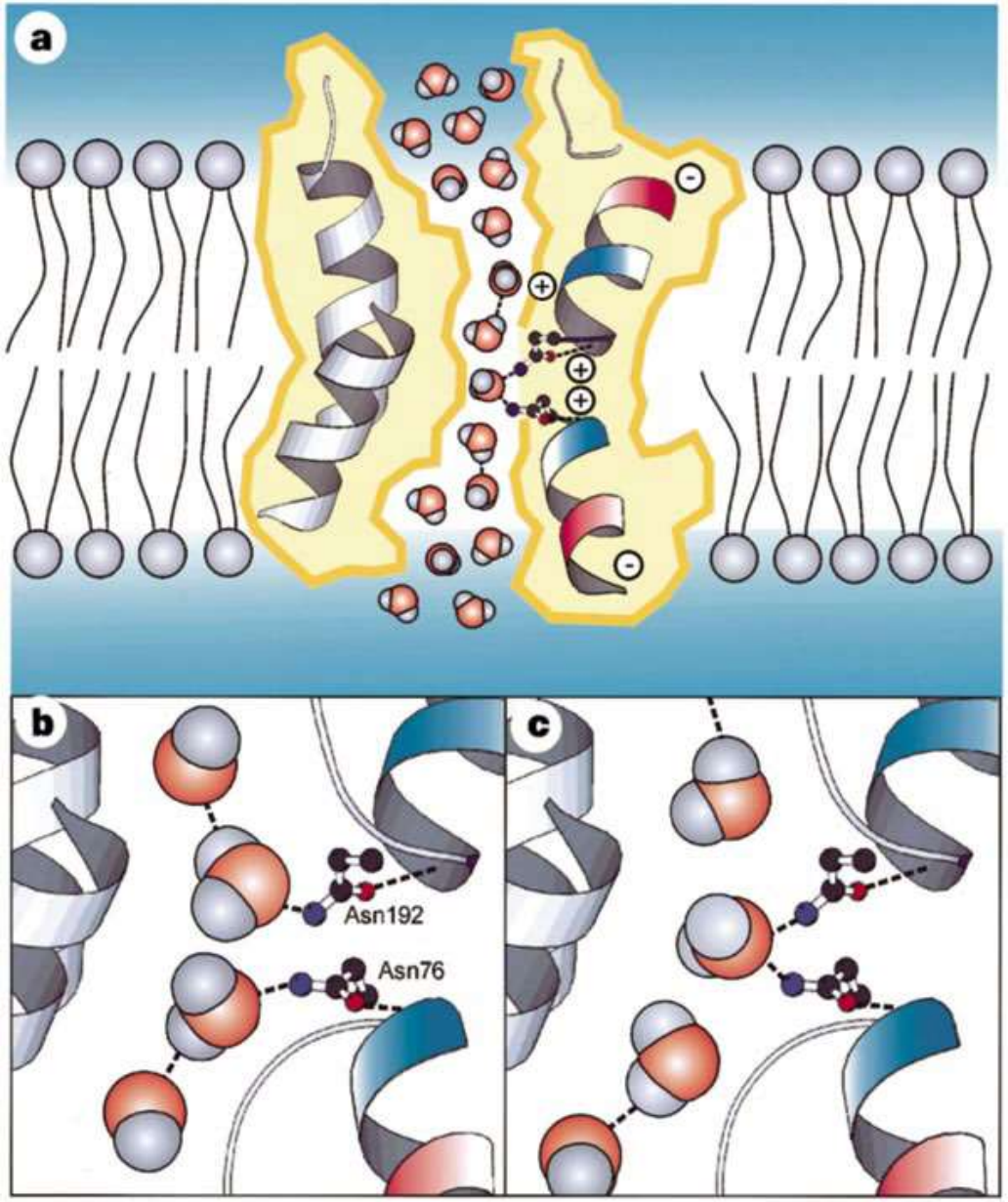
Structure of AQP1

Membrane crystallography (with Y. Fujiyoshi, Kyoto and A. Engel, Basel)



Walz *et al., J Biol Chem,* 1994; *EMBO J,* 1994; *Nature Struct Biol,* 1995; *J Mol Biol,* 1996; *Nature* 1997; Mitsuoka *et al., J Struct Biol,* 1999; Murata *et al., Nature,* 2000

AQP1 permeation by water but not protons

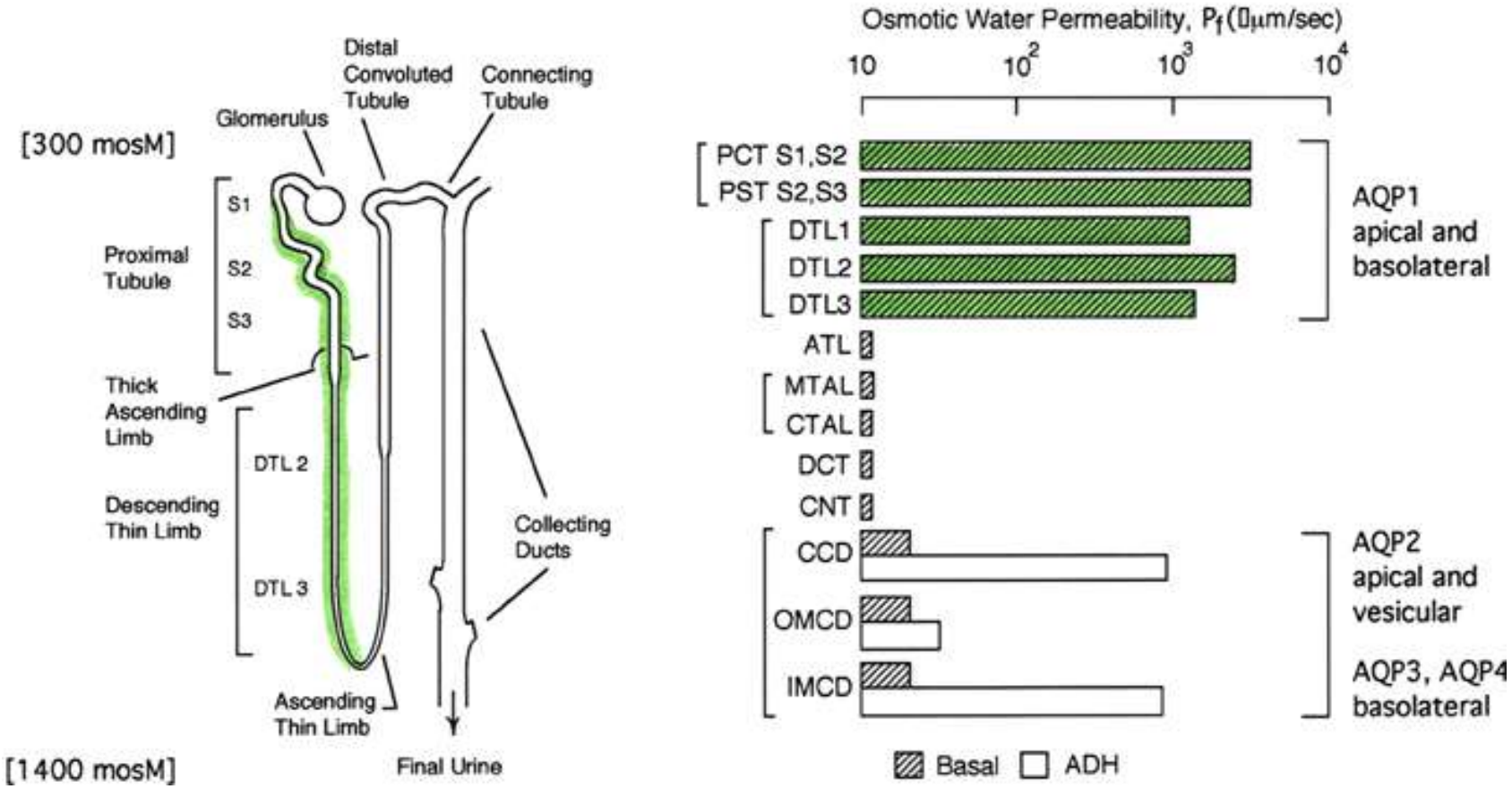


Murata *et al.*, *Nature,* 2000

Localization of AQP1 in kidney

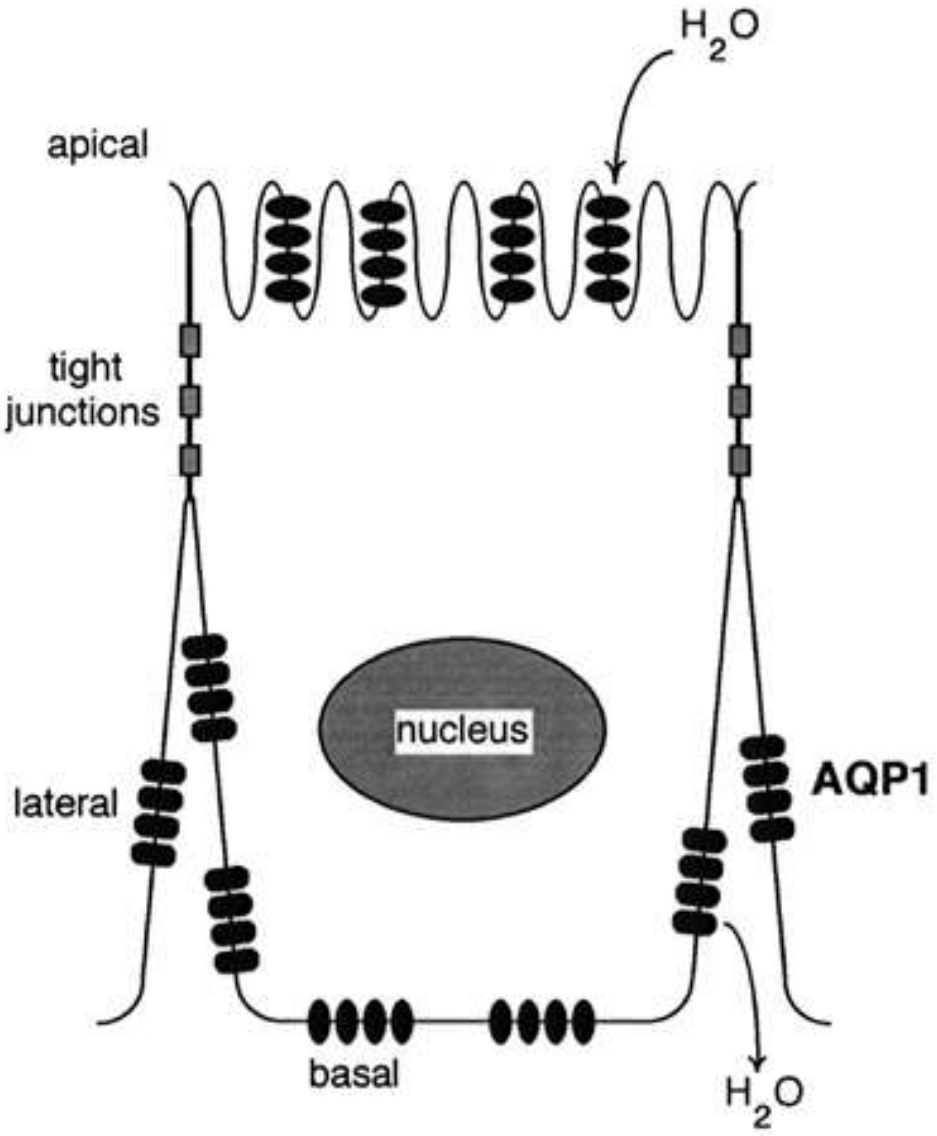
(with Søren Nielsen, Aarhus)

Aquaporin distribution—Renal water permeability



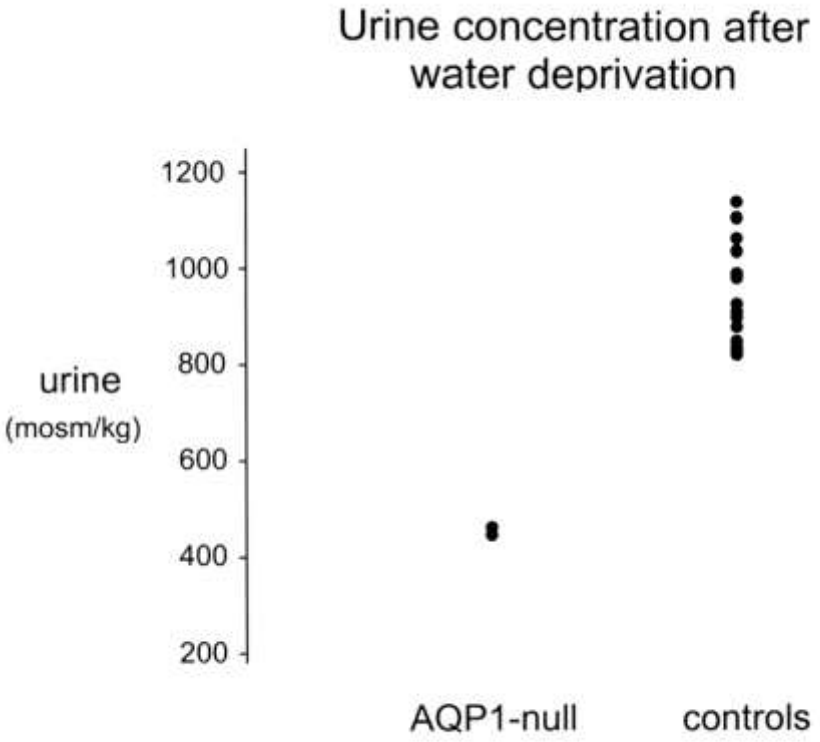
Nielsen *et al.*, *J Cell Biol*, 1993

AQP1-mediated constitutive transcellular water movements



AQP1 null humans—Renal concentration defect

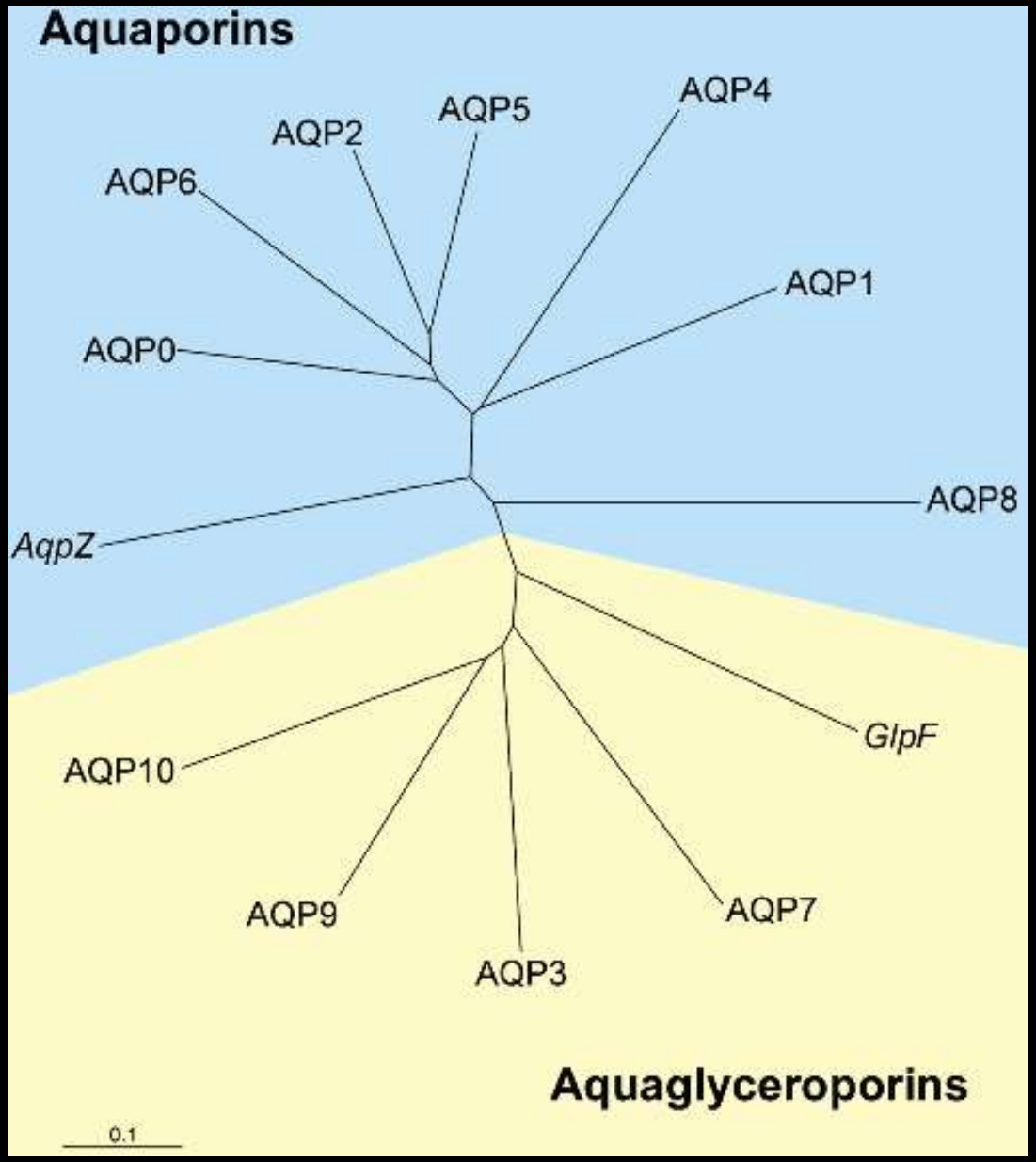
(Landon King and Mike Choi, JHMI)



Dx—Mild Nephrogenic Diabetes Insipidus

King *et al., New Engl J Med, 2001*

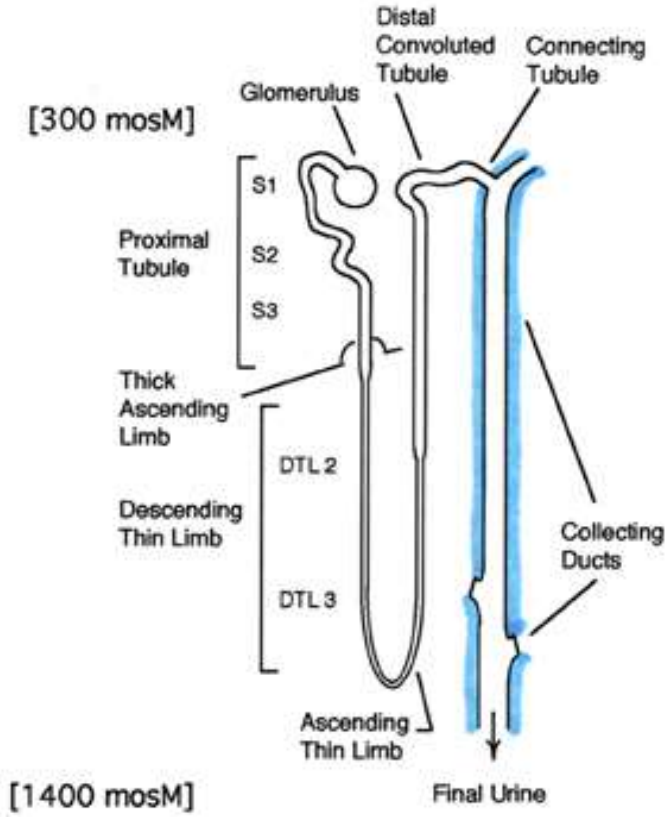
Human Aquaporin Repertoire



AQP2—A regulated water channel

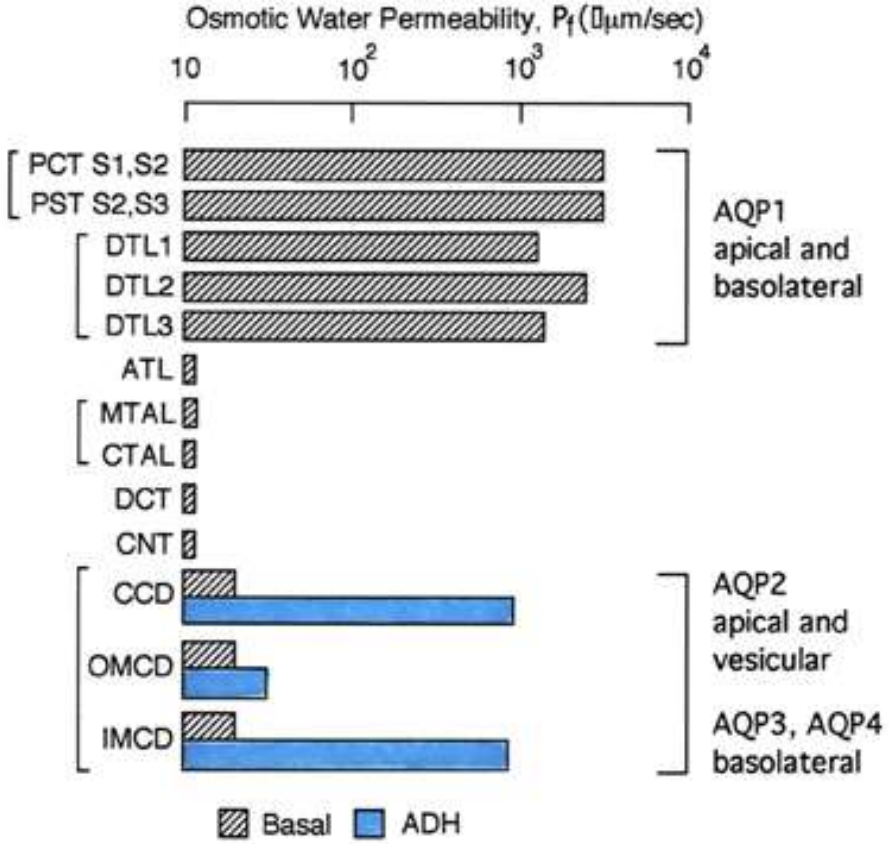
cDNA cloned by homology

(Fushimi *et al., Nature,* 1993)



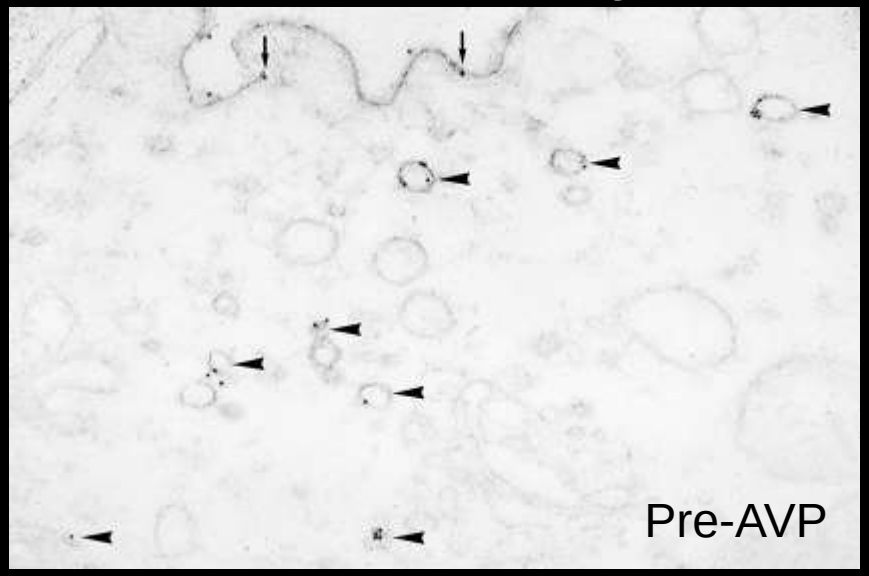
AQP2 localization in kidney

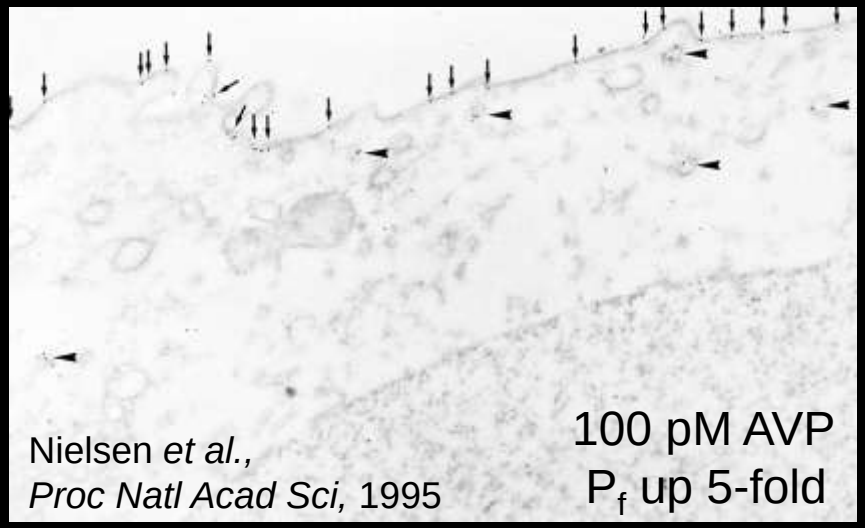
(Nielsen *et al., Proc Natl Acad Sci,* 1993)



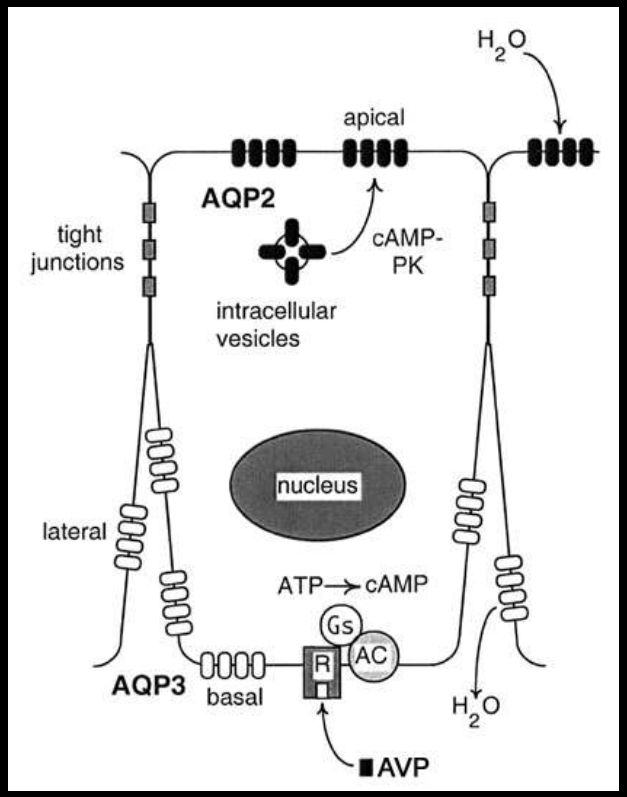
AQP2—Acute regulation by AVP

Isolated renal collecting ducts





Nielsen *et al.*,
Proc Natl Acad Sci, 1995



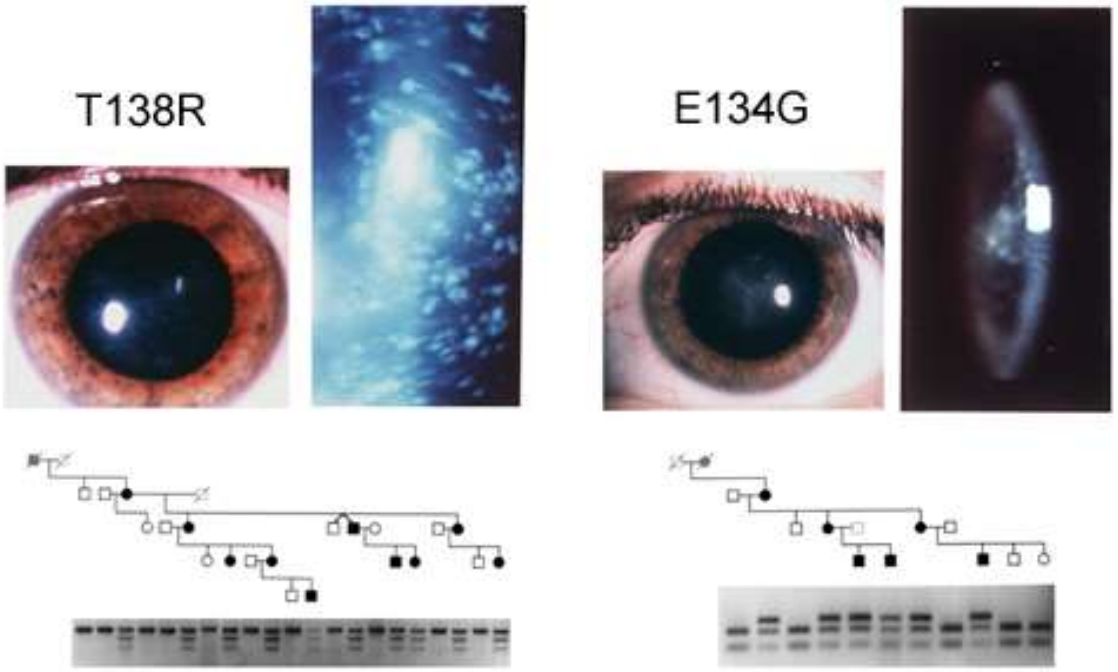
Inherited defects (rare)

- Nephrogenic DI (severe)

Acquired defects (very common)

- Overexpression—Fluid retention
- Underexpression—Enuresis

AQP0 and congenital cataracts



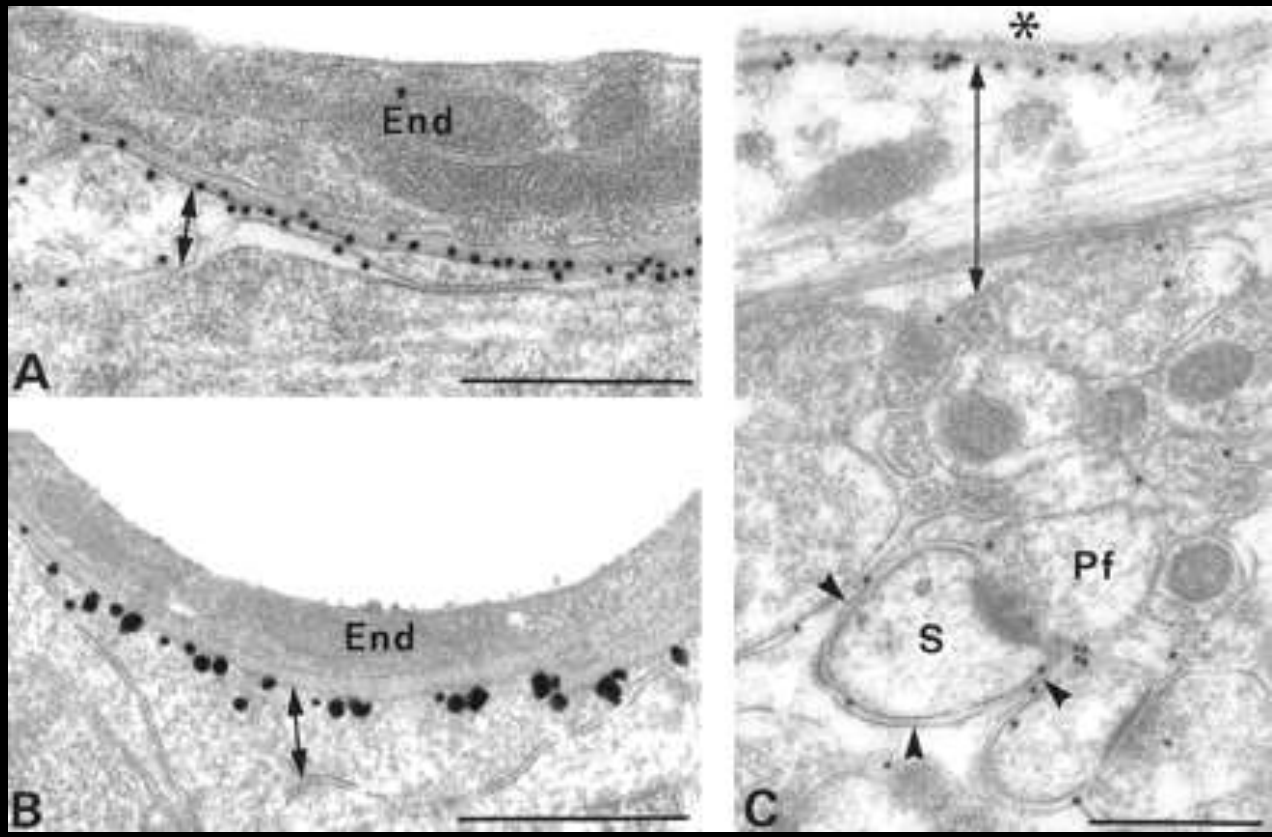
Francis *et al., Human Mol Genetics* 2000

AQP4—Blood brain barrier

(with Ottersen, Oslo; Nielsen, Aarhus; Bourque, Montreal)

Astroglial endfeet

Glia limitans



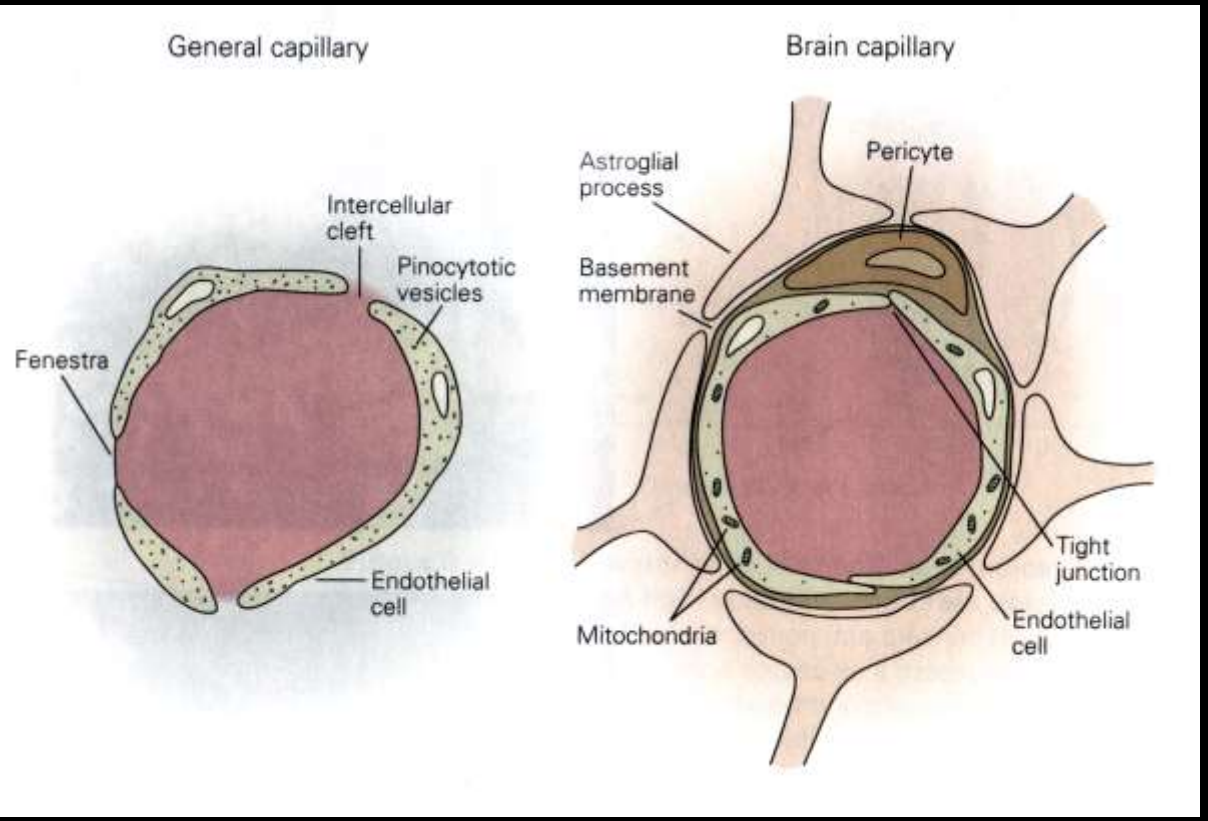
Nielsen *et al., J Neurosci,* 1997
Nagelhus *et al., J Neurosci,* 1998

Does AQP4 provide a pathophysiological barrier?

Manley *et al., Nature Medicine,* 2000

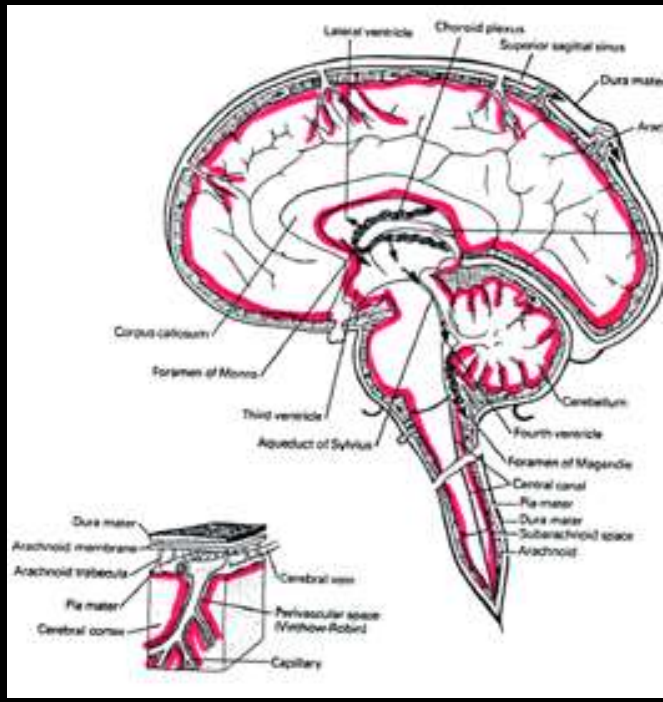
AQP4—Blood brain barrier

Astroglial end-feet surround CNS capillaries



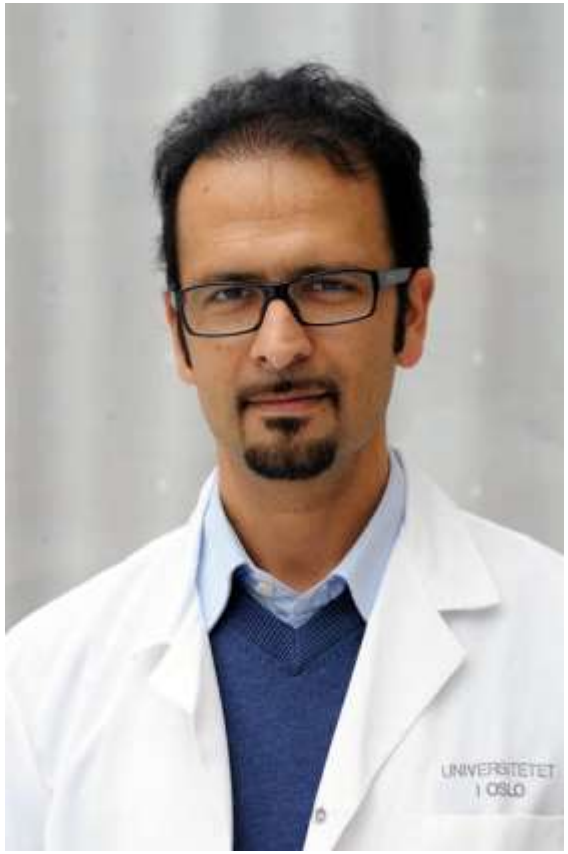
Jessel, Schwartz, and Kandel, 2002

Cloned from brain
- Ependymal cells
- Astroglia



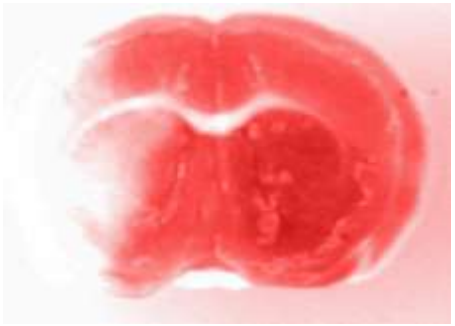
Jung *et al., Proc Natl Acad Sci,* 1994
Hasegawa *et al., J Biol Chem,* 1994

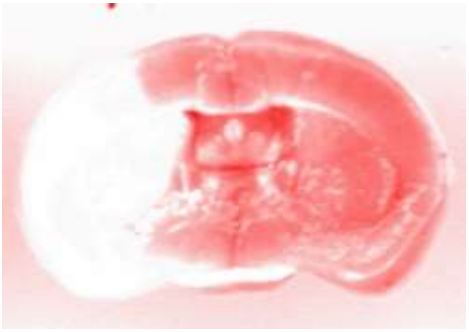
AQP4—accelerated brain damage

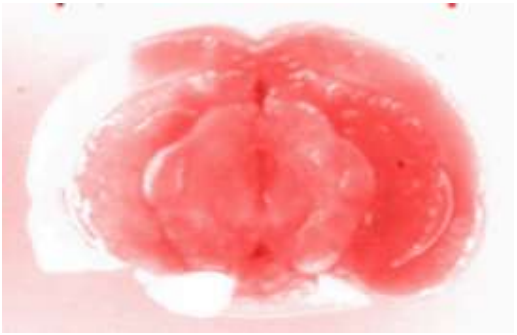


Amiry-Moghaddam *et al.,*
Proc Natl Acad Sci 2003

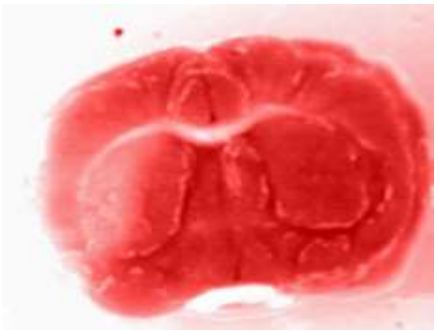
Normal Mouse

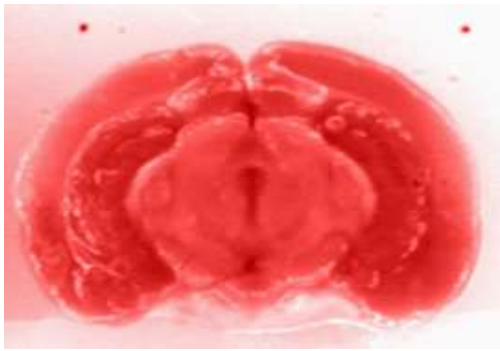


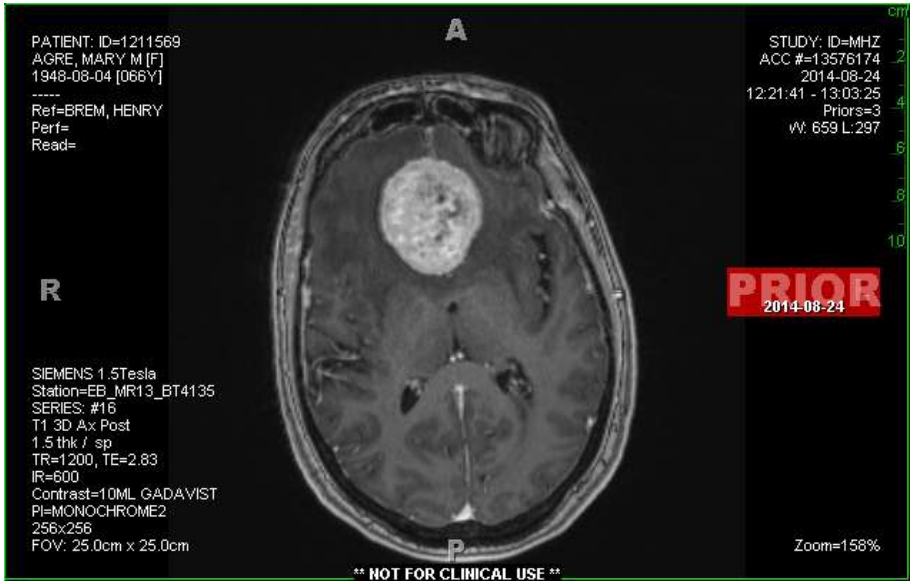




Mutant Mouse



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1948-08-04 [066Y]

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R
P
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2014-08-24
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1.5 thk / sp
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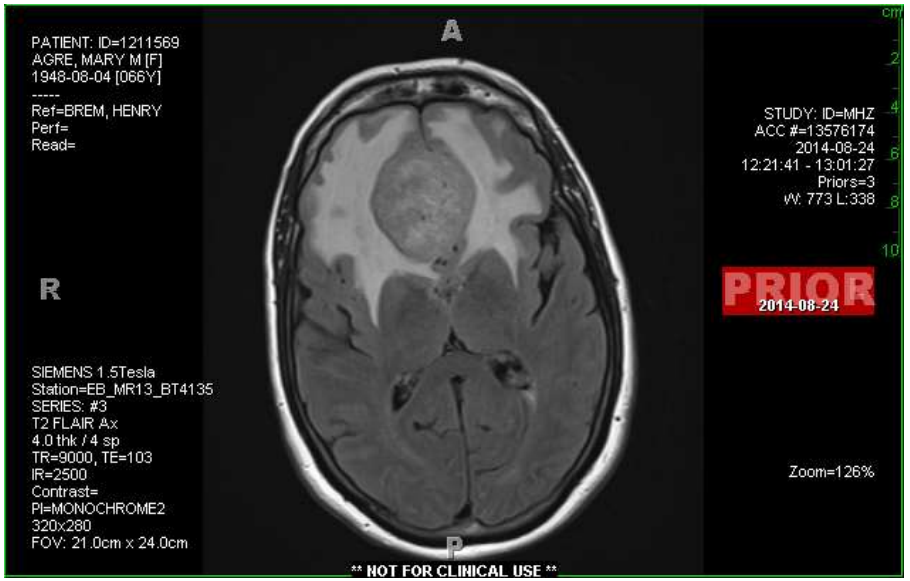
** NOT FOR CLINICAL USE **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T2 FLAIR Ax
4.0 thk / 4 sp
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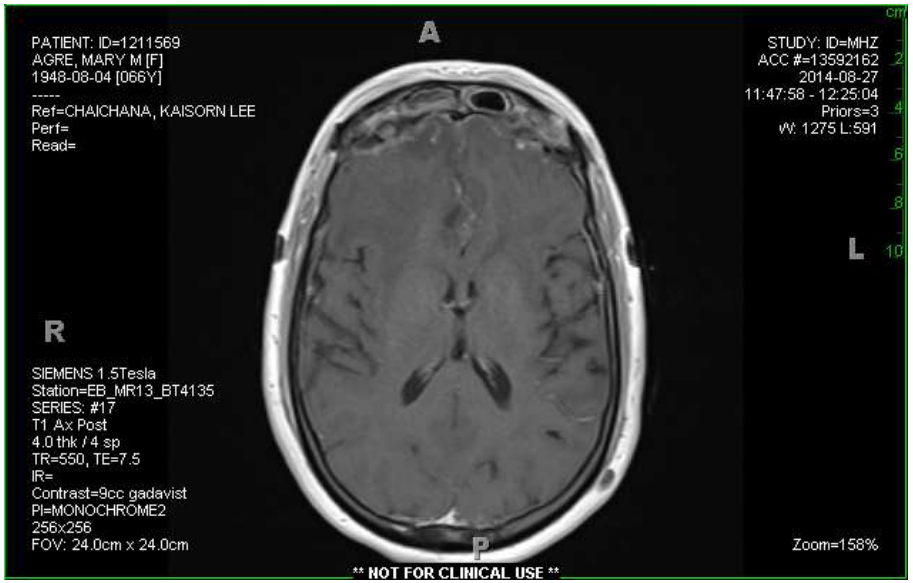
** NOT FOR CLINICAL USE **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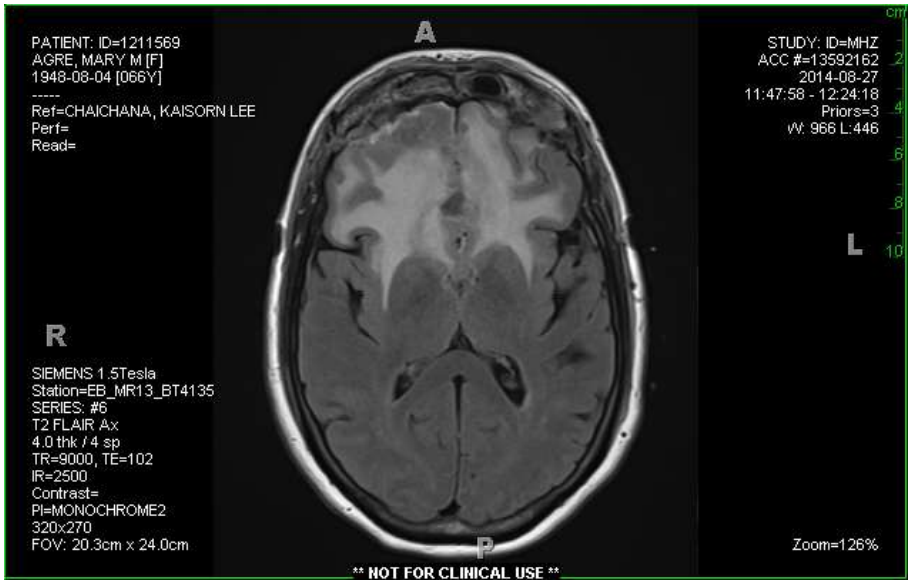
** NOT FOR CLINICAL USE **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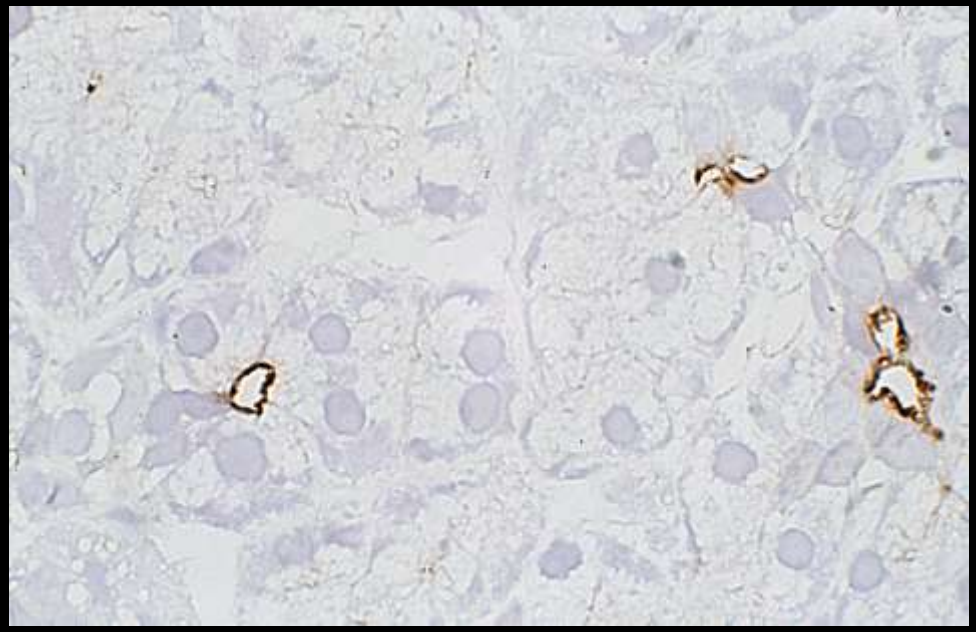
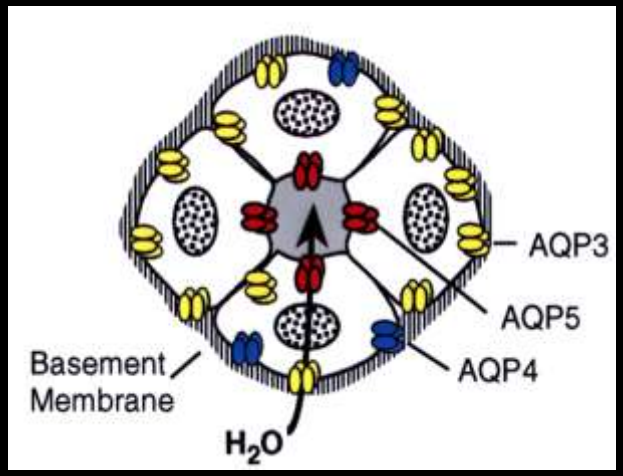
FOV: 20.3cm x 24.0cm
Zoom=126%
** NOT FOR CLINICAL USE **

AQP5—Secretory glands

cDNA cloned from salivary gland
Lacrimal, submucosal, and
sweat glands



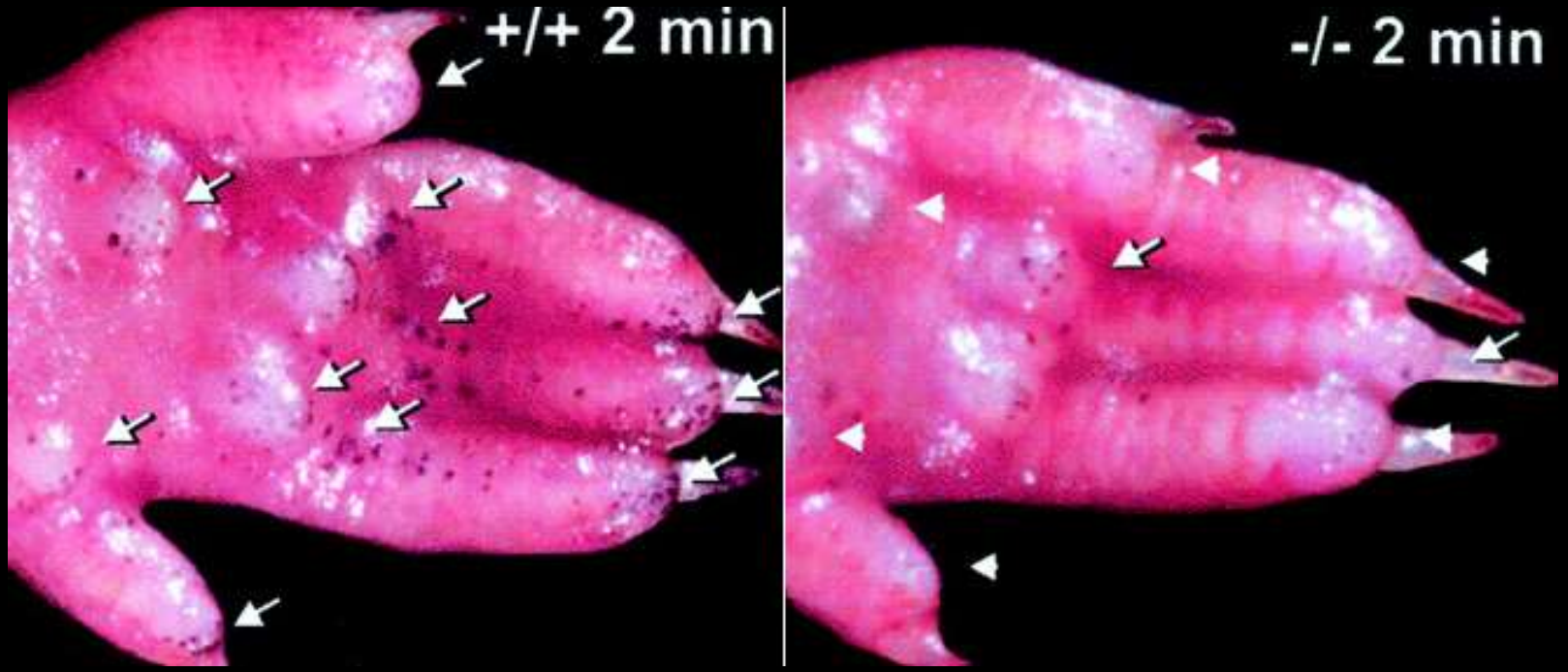


Raina *et al., J Biol Chem,* 1995

Nielsen *et al., Am J Physiol,* 1997

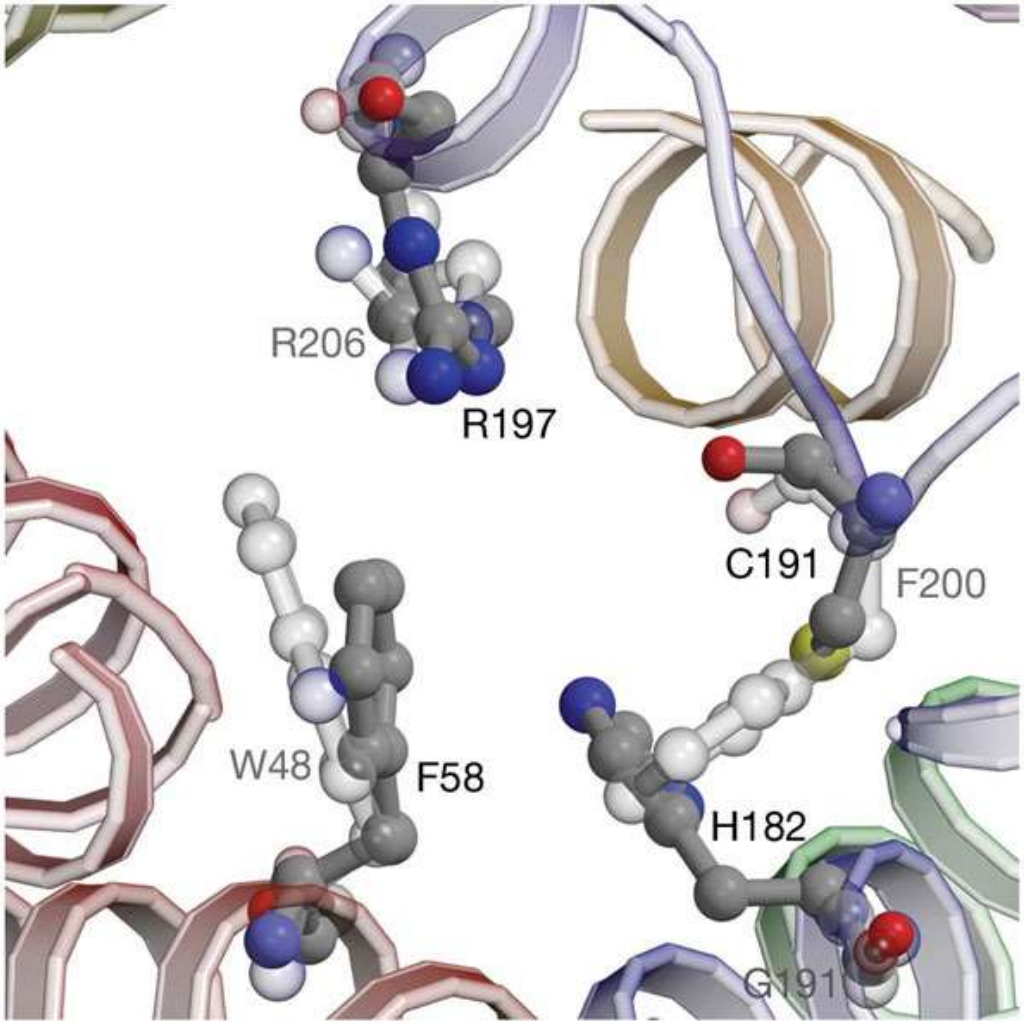
AQP5—Secretory glands

Pilocarpine induced sweat gland function—Wild type vs. AQP5 null mice



Nejsum *et al., Proc Natl Acad Sci,* 2002

Pore diameters AQP1 vs GlpF



Sui *et al., Nature,* 2001

Jamais votre peau n'a été aussi belle.

HYDRACTION

La déshydratation se ressent mais surtout elle se voit : teint terne, ridules de déshydratation,...
Pour en finir, Dior crée HYDRACTION, un soin hydratant* innovant aux résultats spectaculaires !

Hydratation Profonde : irriguée** grâce à la technologie Aquaporine exclusive, votre peau retrouve un confort extrême et longue durée.

Hydratation Visible : désaltérée grâce au complexe Aquacapt™, votre peau renaît, belle et pulpeuse.

Des résultats spectaculaires :

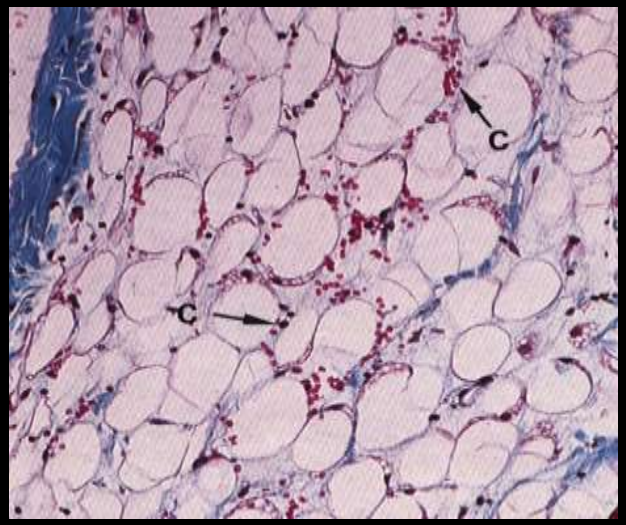
71% des femmes se trouvent plus belles après application d'HYDRACTION***

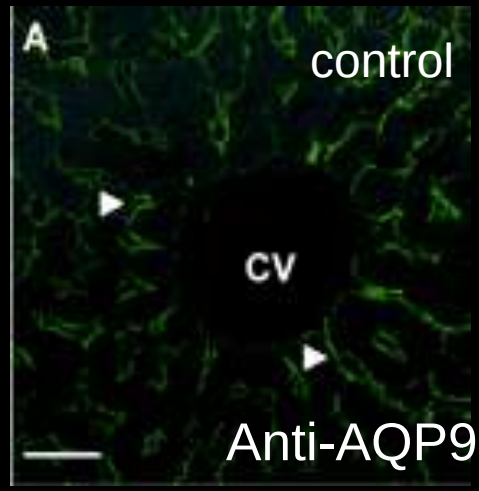
Les travaux liés à l'exceptionnelle découverte du rôle des aquaporines en général ont été récompensés par le Prix Nobel de Chimie en 2003.

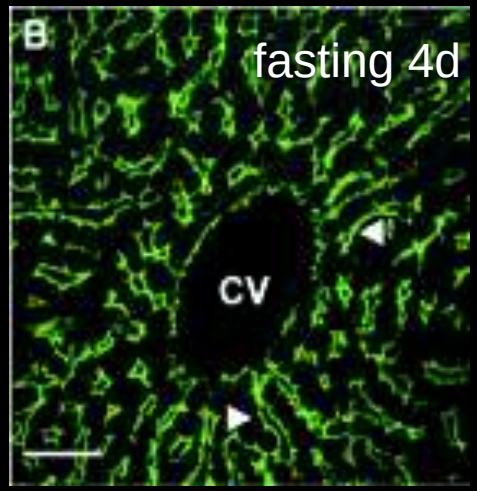
AQP7 and 9—Glycerol metabolism

AQP7 in adipose tissue
- Glycerol + water permeation
- Suppressed by insulin

AQP9 in liver
- Glycerol, water, urea permeation
- Increased by fasting or diabetes





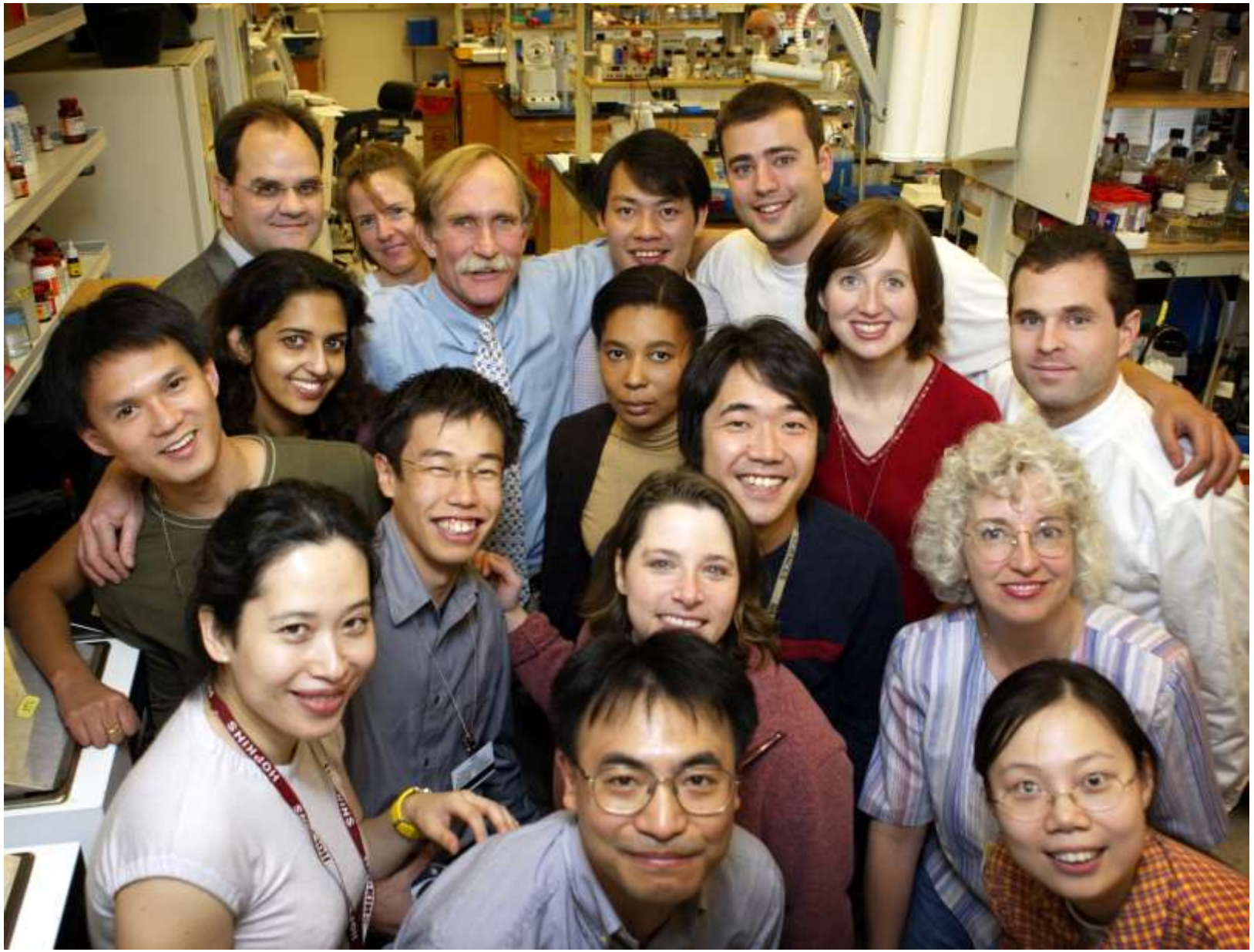


Kishida *et al., J Biol Chem,* 2000
Kuriyama *et al., Diabetes,* 2002

Tsukaguchi *et al., J Clin Invest,* 1998
Carbrey *et al., Proc Natl Acad Sci,* 2003

Starvation—AQP7 releases glycerol derived from fat catabolism.
AQP9 facilitates hepatic glycerol uptake for gluconeogensis.

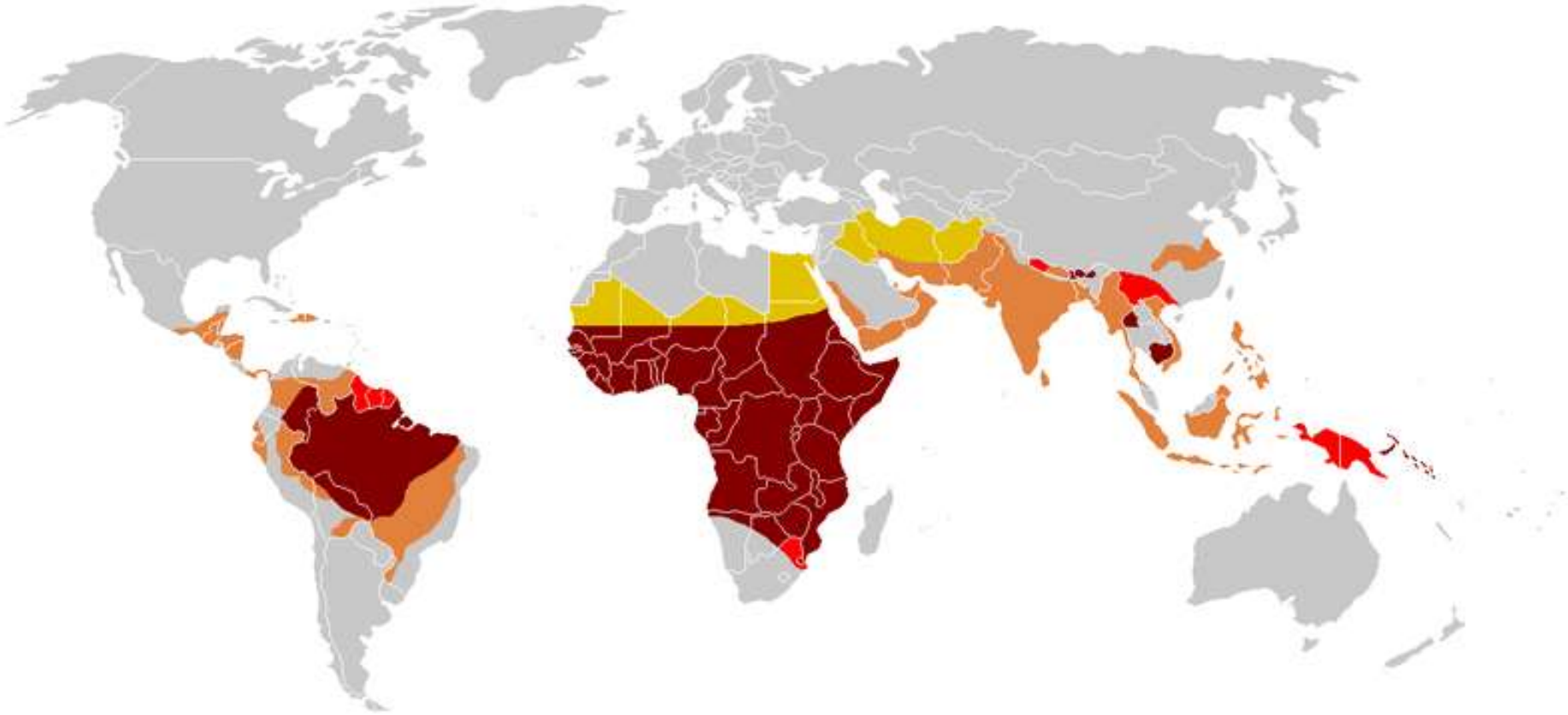
8 October 2003

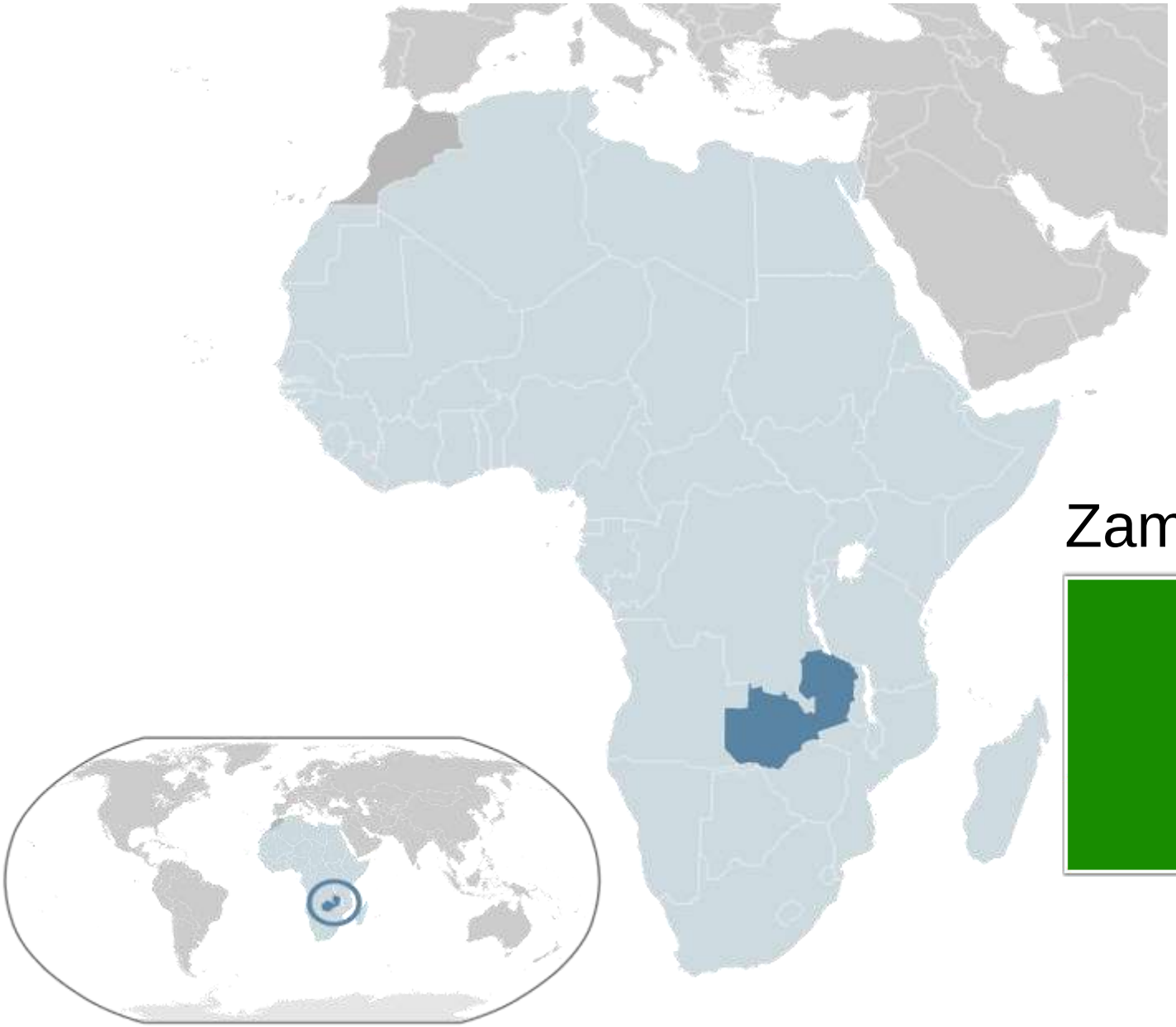


10 December 2003

World Malaria Map

NIH International Centers of Excellence
for Malaria Research

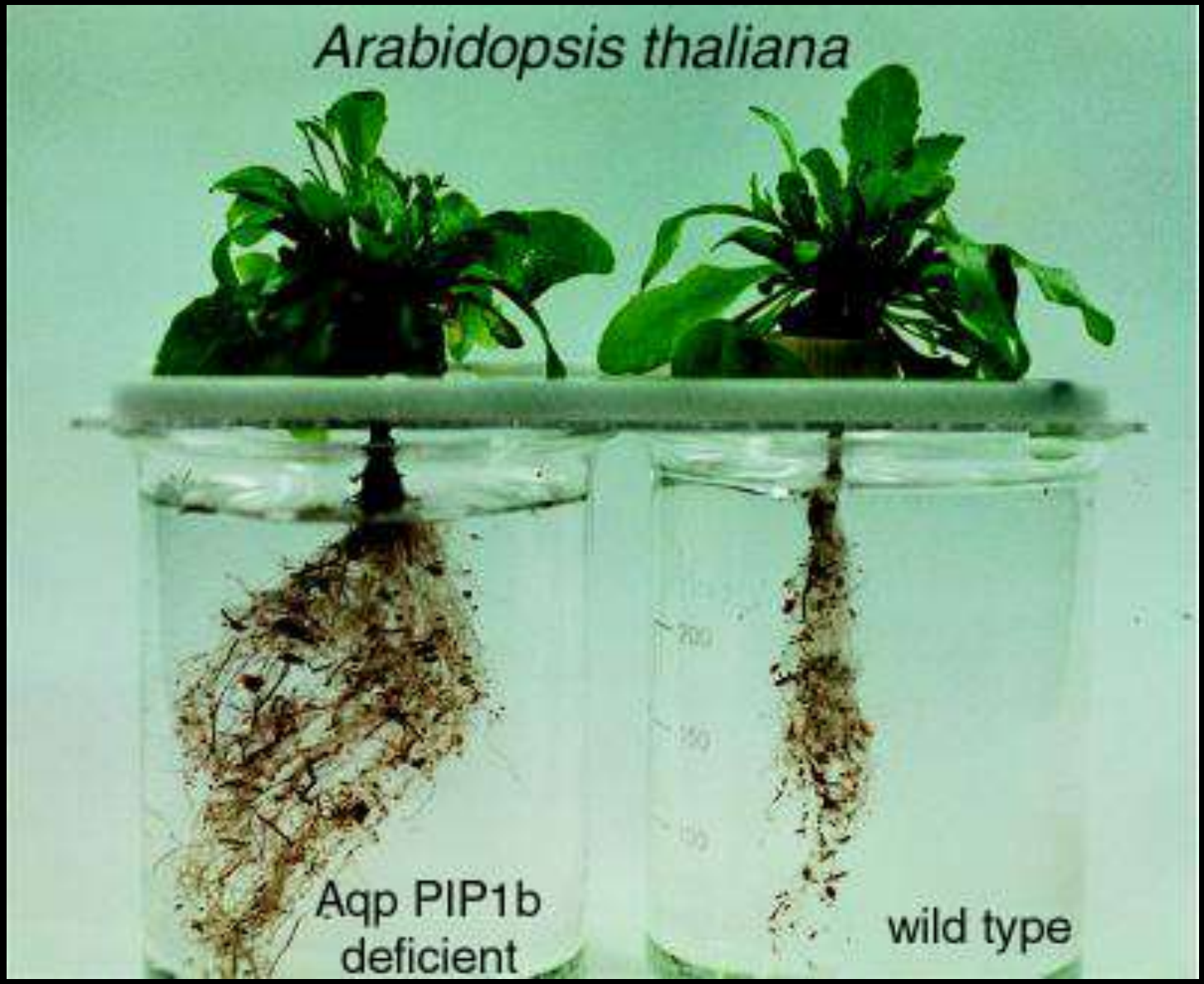




Zambia


J & J
COFFINS
& CASKETS
UNITURTLE AGENTS
SINMBE ENT
AUTO PARTS MOTOR BIKE SPARES
CANTER

Children of rural Africa


Arabidopsis thaliana
Aqp PIP1b
deficient
wild type

Anopheles gambiae


MALARIA INSTITUTE
AT MACHA
MACHA MALARIA
RESEARCH INSTITUTE
JHMRI
JOHNS HOPKINS MALARIA RESEARCH INSTITUTE

Consequences of cerebral malaria


MALARIA INSTITUTE
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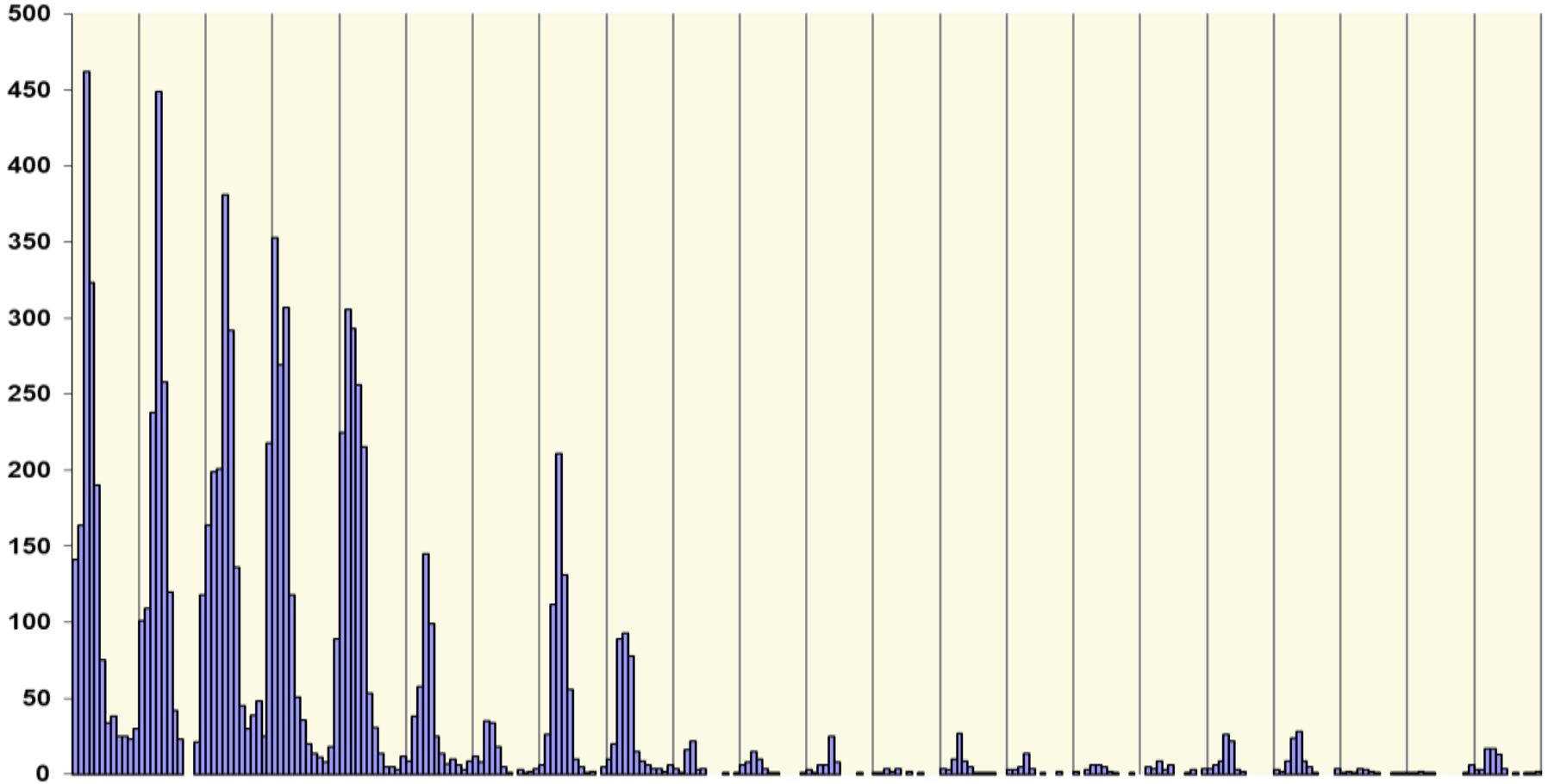
JHMRI
Land Cruiser


JHMRI
Johns Hopkins
Malaria Research
Institute


POPS

Child Malaria - Macha Hospital, Zambia



Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Malaria Cases	1530	1479	1778	1294	1418	423	123	565	336	52	46	50	15	62	32	26	35	72	85	17	13	62
Malaria Deaths	60	106	65	32	34	18	6	24	24	2	2	5	1	3	2	1	3	5	2	0	0	0

Wei Ji

Mandarin for “crisis”

danger opportunity

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