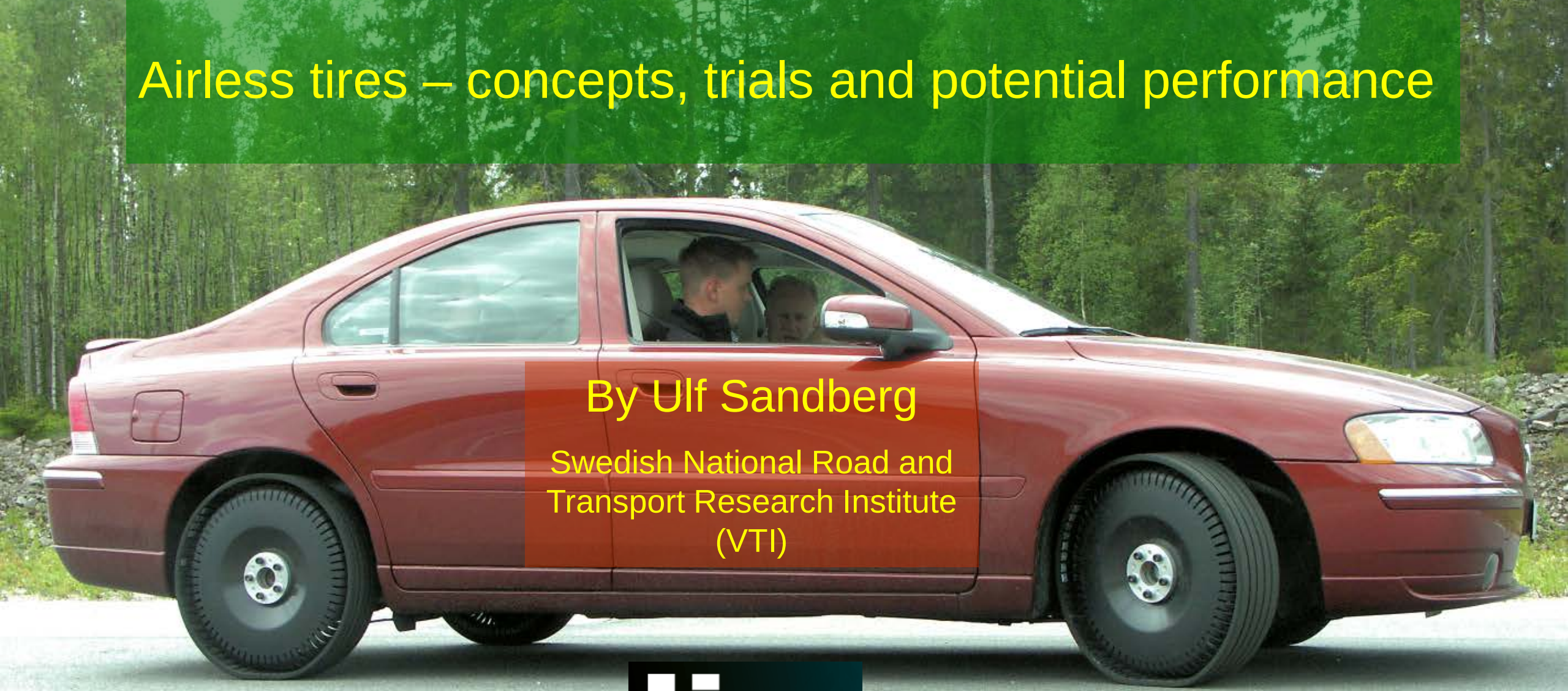
Airless tires – concepts, trials and potential performance



By Ulf Sandberg

Swedish National Road and Transport Research Institute (VTI)

Hanover, Germany

tire technology EXPO 2022

18, 19, 20 May 2022

The pneumatic tire has been the only feasible tire principle now for >100 years

Basic shape (profile) of the Goodyear ”Integral Wheel-Tire”

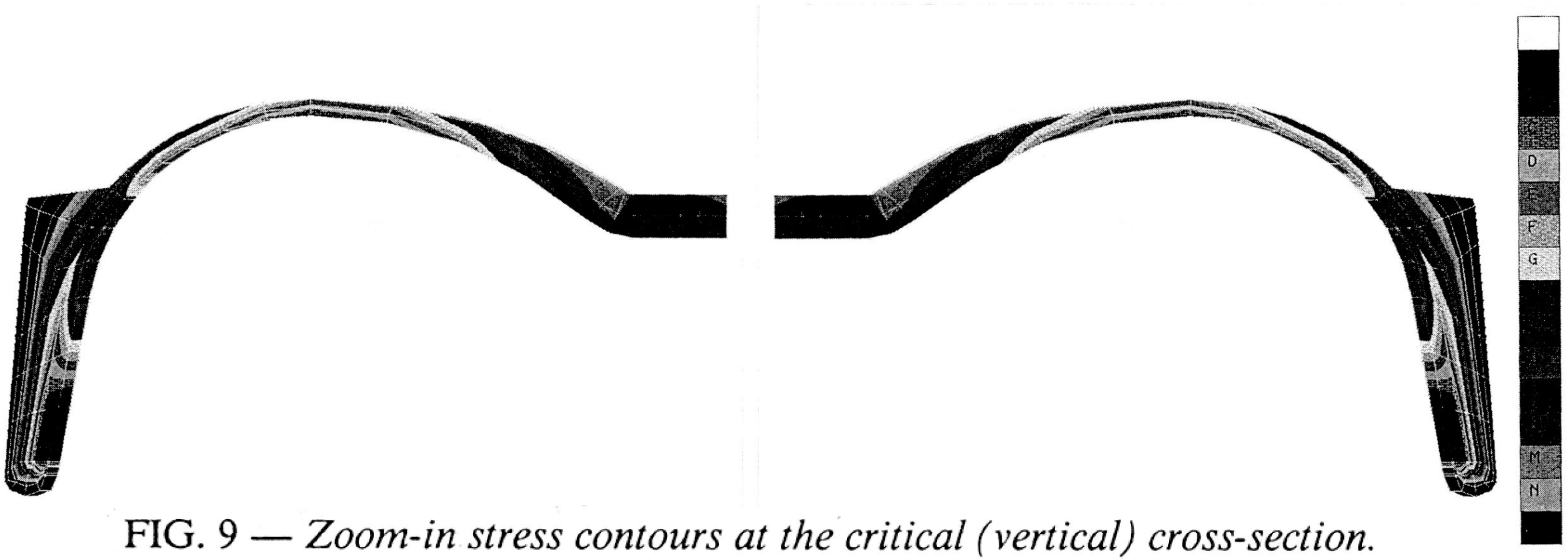


FIG. 9 — *Zoom-in stress contours at the critical (vertical) cross-section.*

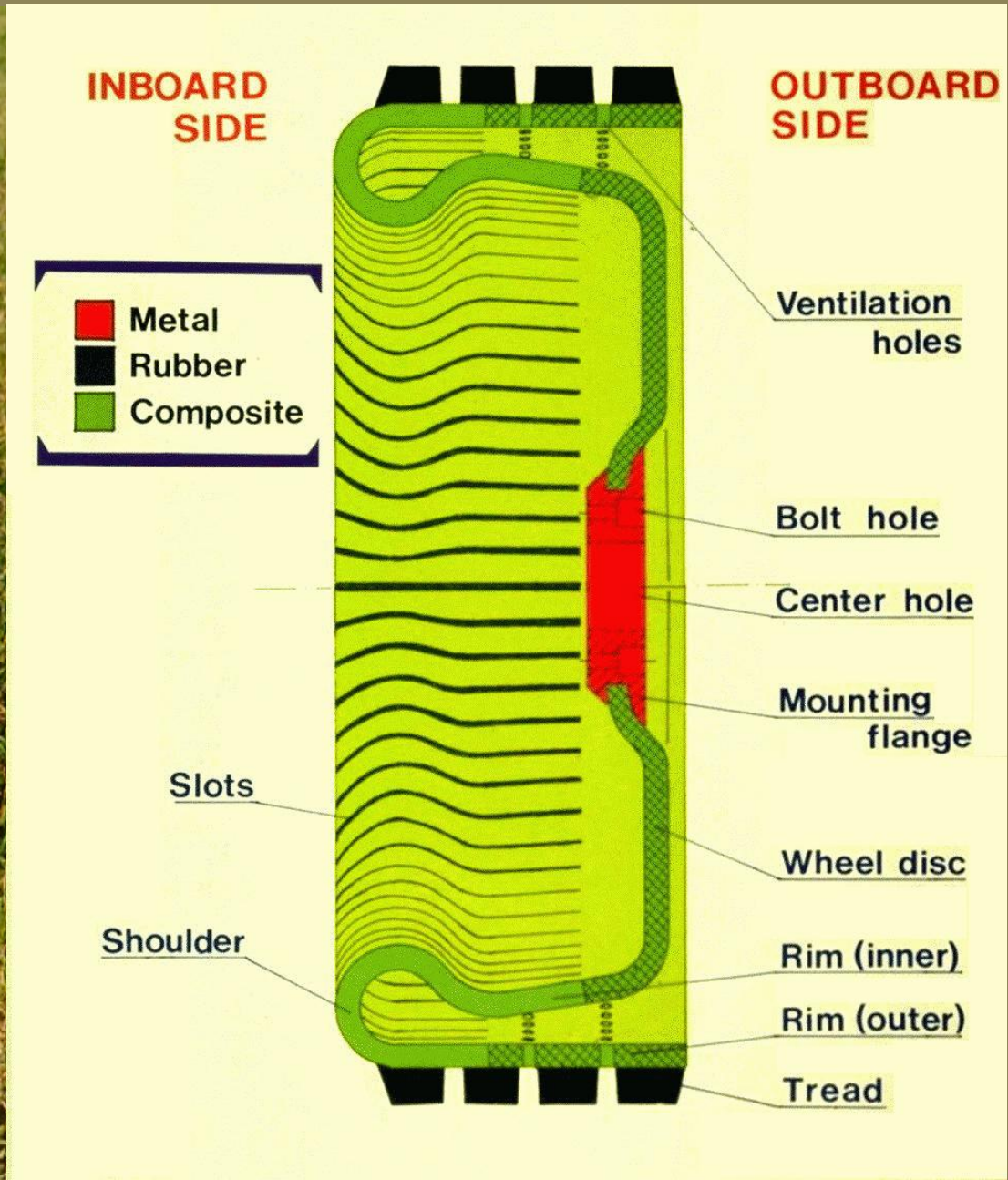
From Tire Science and Technology, 1982

The Goodyear design (1982)

The ”Composite wheel” 1989-90 tested at VTI

Inventor:

H E Hansson,
Sweden

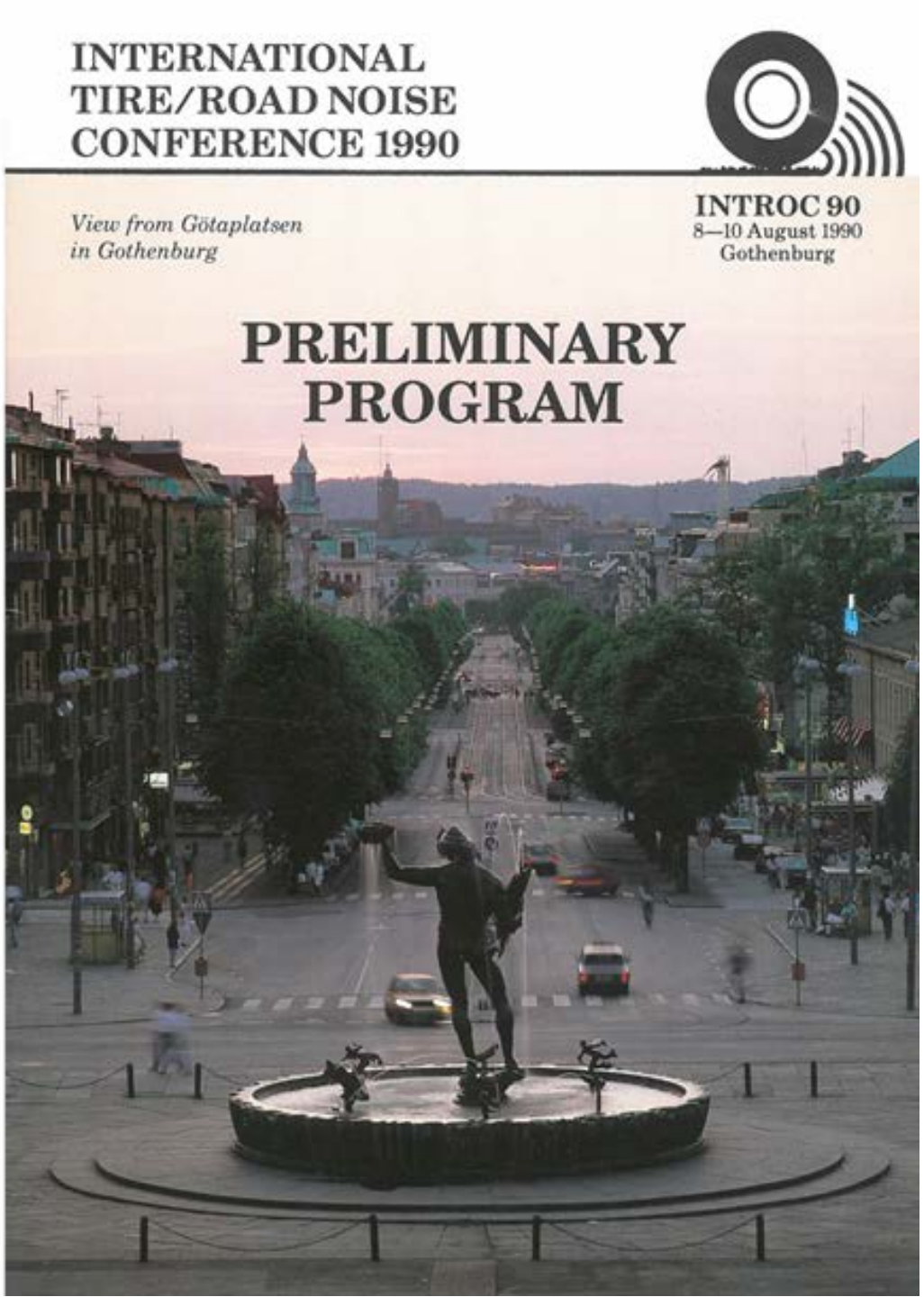


The ”Composite wheel” 1989-90

Aim:
Noise
reduction

-10 dB(A)
but not
sufficient durabilty

Three papers at the 1990 tire/road noise conference about the Composite Wheel



International conference in Gothenburg, Sweden

Full-scale on-road tests in 1991

10 years later:

Concept tire, for Volvo cars

Looked GREAT, but may be too noisy?

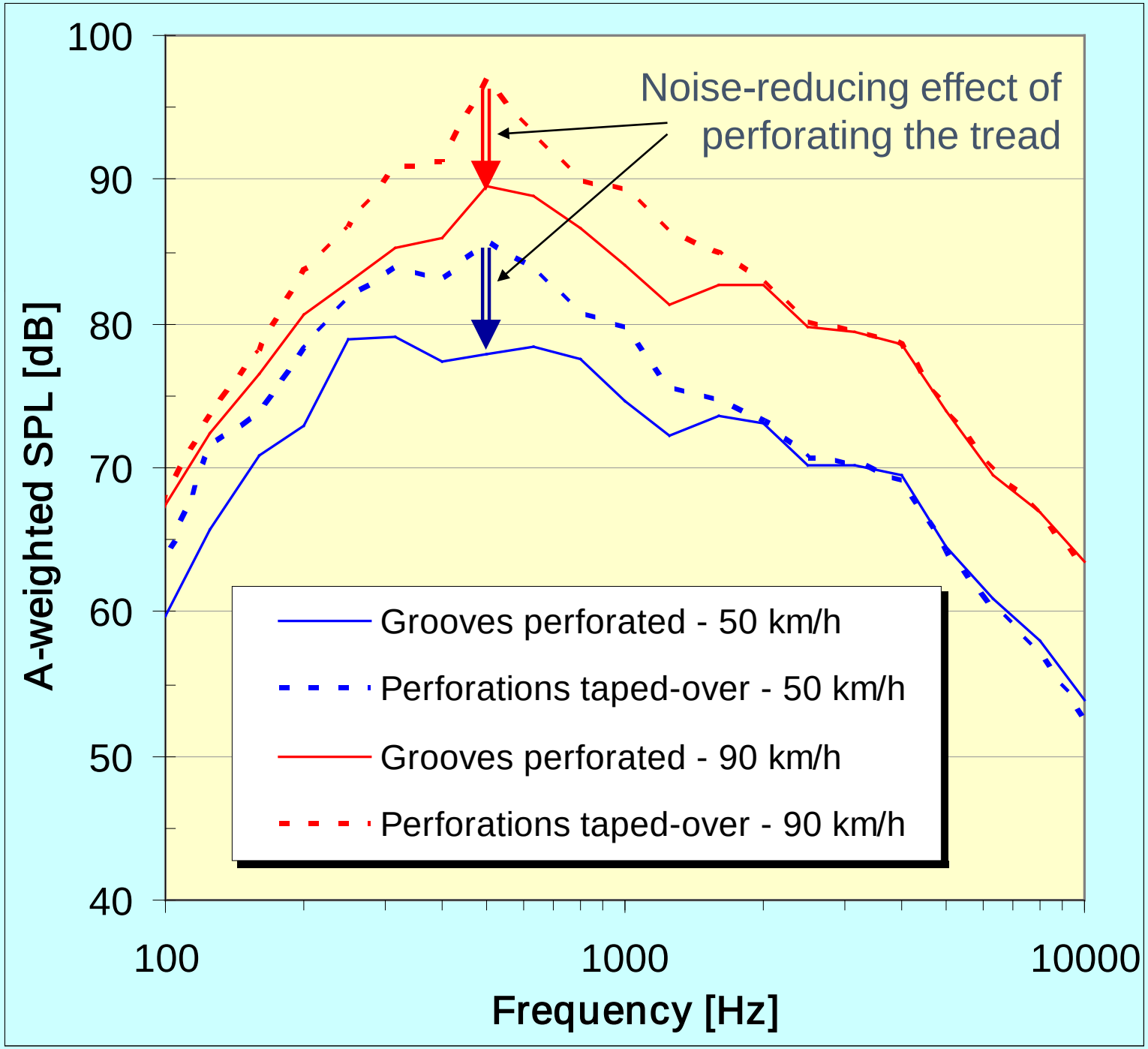
Mr Hans-Erik Hansson (inventor)

New international project led by VTI

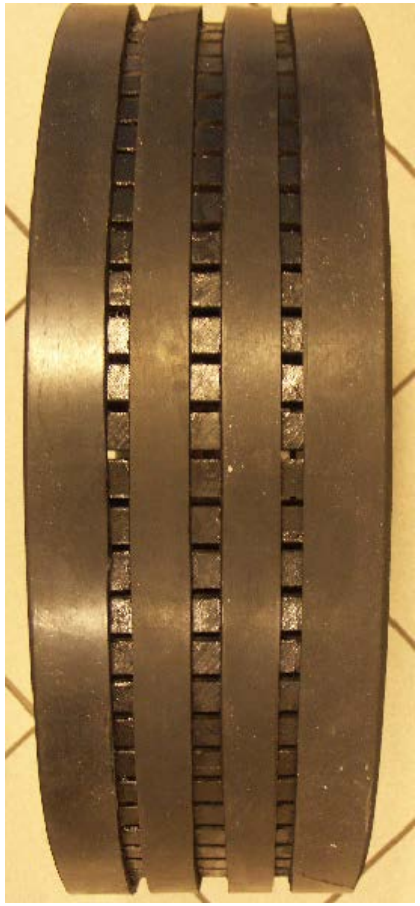
Our starting point in 2002:

A composite wheel made for Volvo (Design Dept.)

17 spokes



Effect of the perforations in the grooves



New ideas: February 2006

71-74 spokes

Activities in the period 2006-2008

6 different versions produced and tested 2006-2008

1-4 variants within each version

Full-scale tests on Volvo S60 test car

Tire/road noise coast-by tests

On ISO Test Track, May 2008

Noise reduction: 5 dB(A)

Results of rolling resistance tests in 2006-2008

Rolling resistance, on laboratory drum (ISO method):

Reduction by 45 % compared to Nokian Hakka V

Reduction by 35 % compared to Michelin Energy Saver


Testing on the
”pothole” track

Too little space for deflection of contact area
when tire deflected on pothole test track

Result: Cracks in the ”spokes”

Some tire manufacturers’ concept airless tires as presented at exhibitions or in press releases

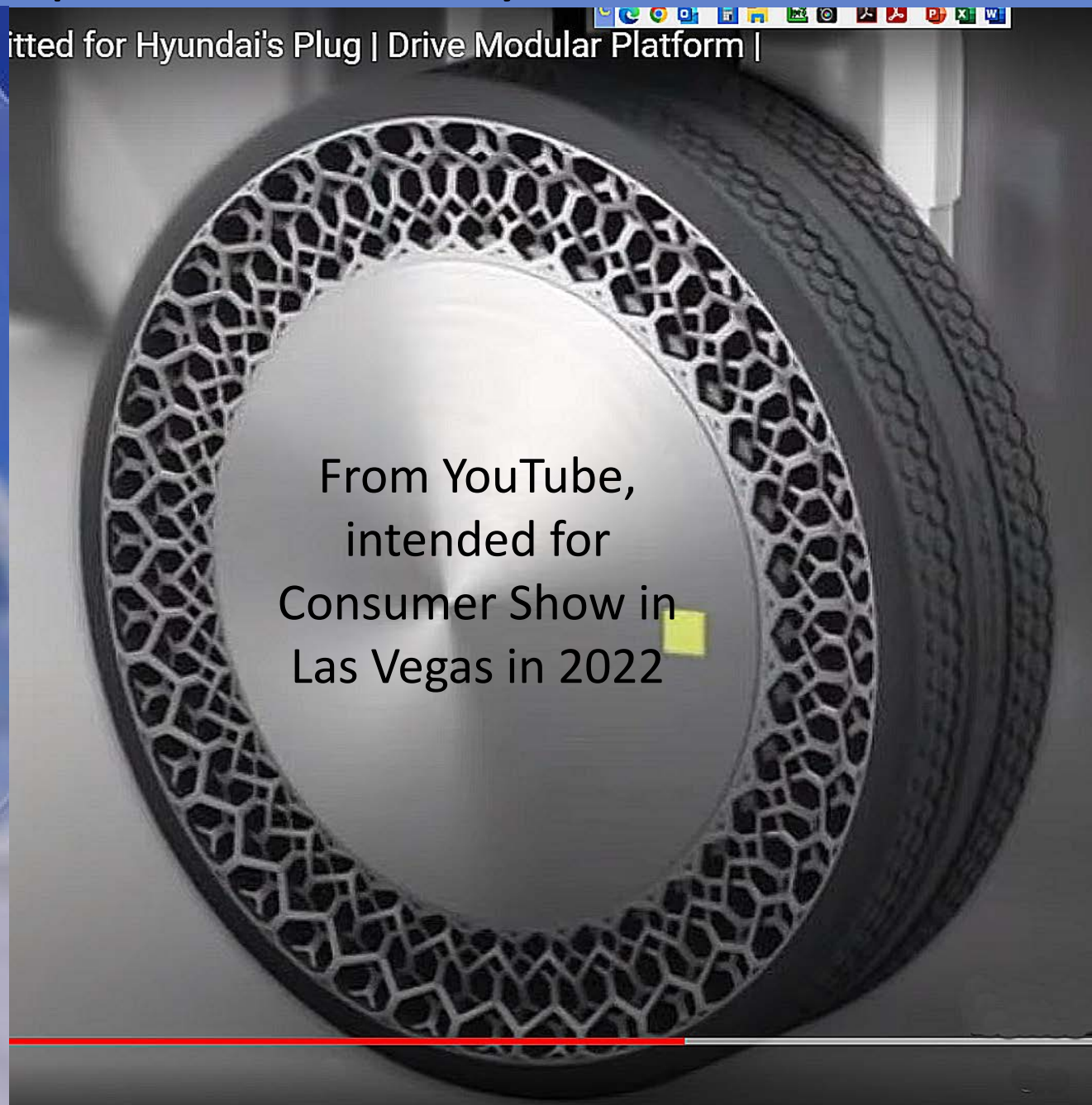
Photo:
Courtesy of
Dr Lin Kung,
Kumho Tires (USA)

Presented
2005

The "Tweel" from Michelin

Michelin TWEEL

Hankook's iFlex, in cooperation with Hyundai



Toyo Tires – concept tire

From TTI, Nov. 2017

Toyo Tires 6th generation

From Japan Rubber Weekly, Jan. 2021

Bridgestone
air-free tire

Goodyear: non-pneumatic tire (NPT)

being tested for urban autonomous vehicle transportation with the Jacksonville Transportation Authority (USA)

From TTI July 2021

Goodyear Speherical tire

From TTI, Sept. 2021

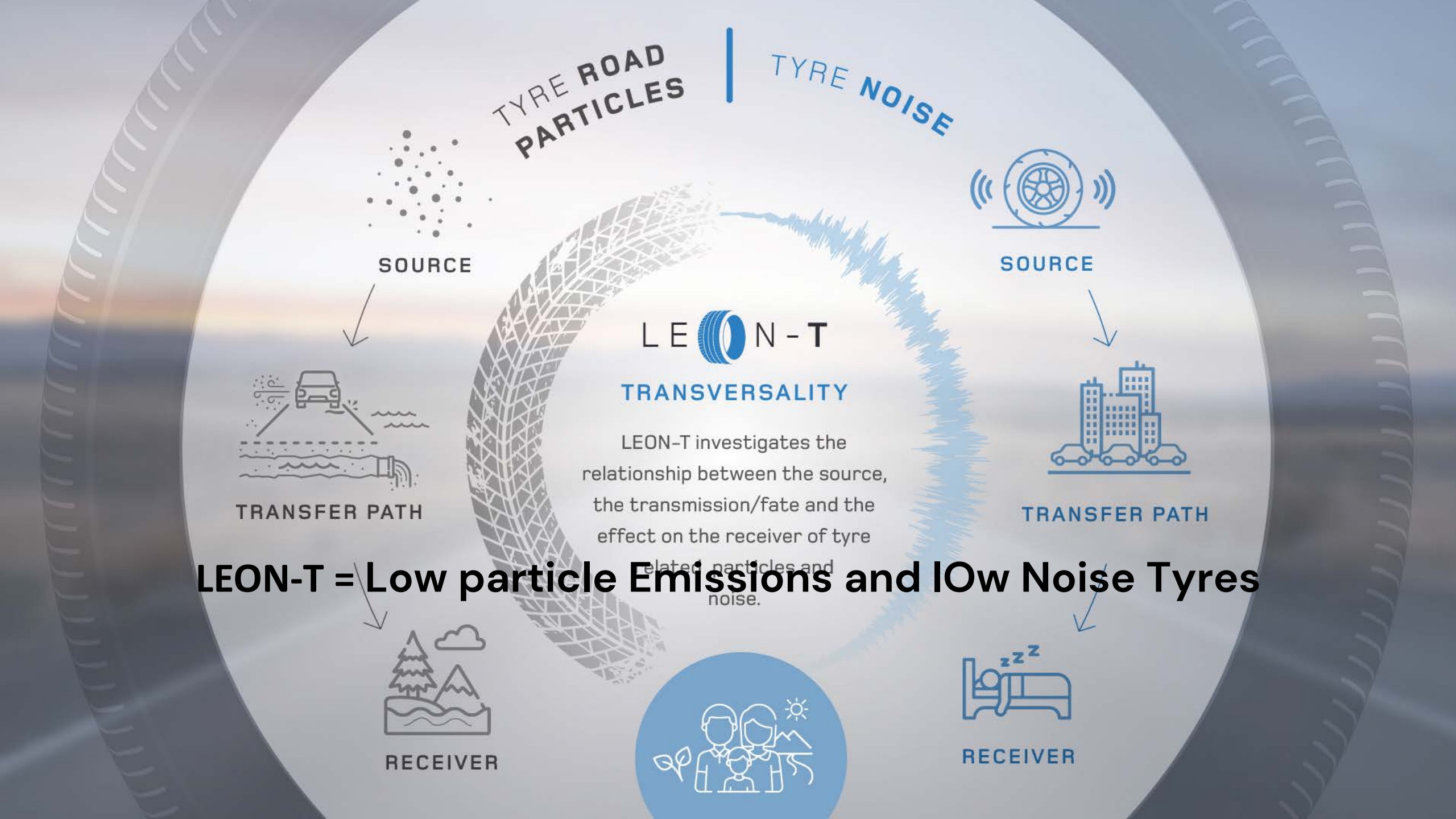
For Citroën concept car

Michelin’s Uptis tire

(Unique Puncture-proof Tire System)

Coop with GM: tests on GM Bolt car

Target 2024



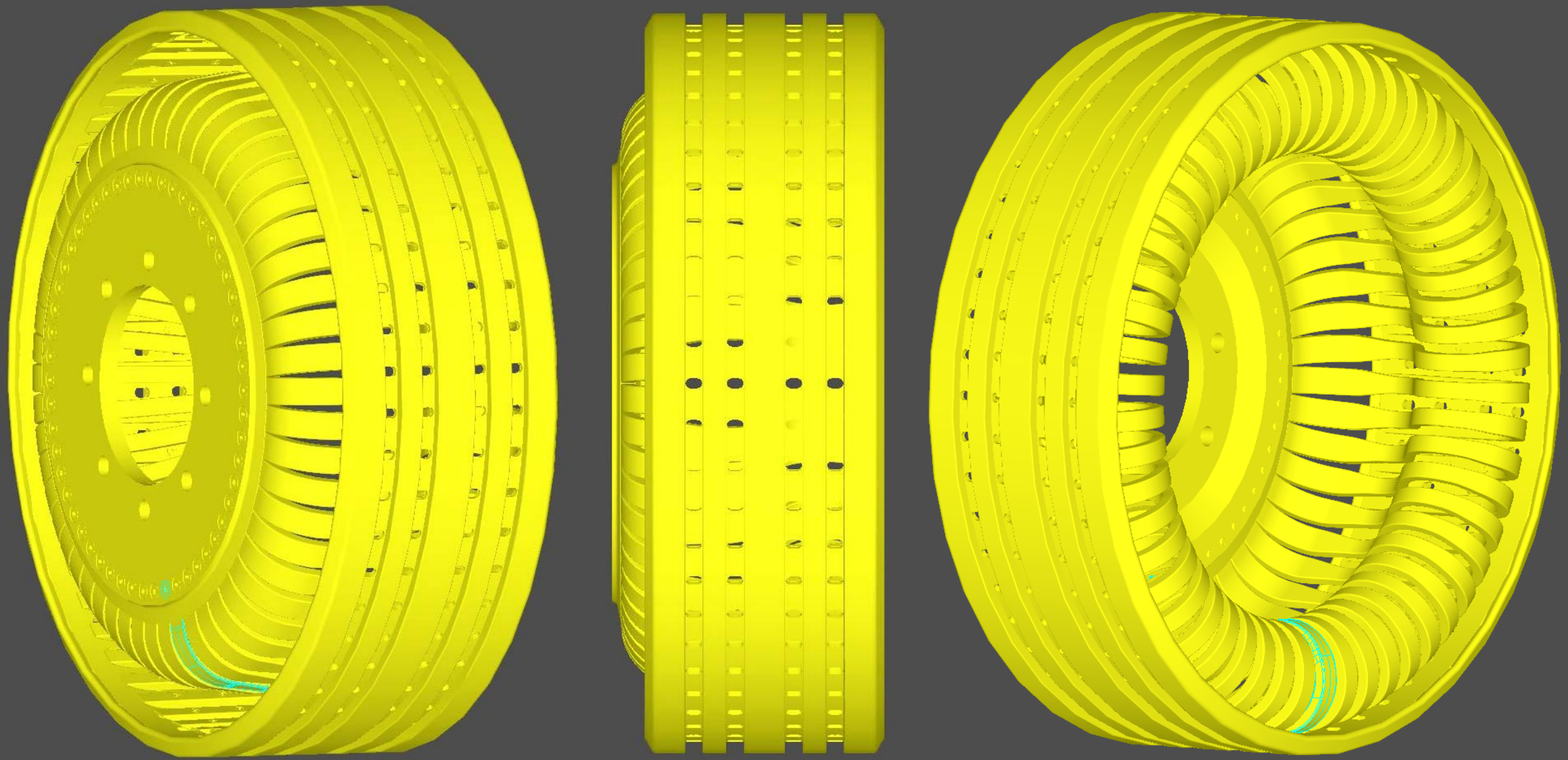
LEON-T = Low particle Emissions and lOw Noise Tyres

LEON-T, Work Package 5:
Development of airless tires for heavy goods vehicles

Partners:
VTI (Sweden – WP Leader)
Euroturbine (Sweden)
Idiada (Spain)
Audi (Germany)
LingLong tires (China)

First we planned
to scale-up the
composite wheel
from 2008
to HGV size
285/70R19.5
LI = 145/143

First trial design - using steel blade spokes



Major challenges

- Strength (load capacity)
- Noise from the ”spoke” impact
- Noise inside vehicles (when the air cushion in pneumatic tires is missing)
- Possible eigenfrequencies in the spokes
- Air cannot be used for adjusting contact patch to varying loads
- The whole tire industry may be rocked if airless tires will become popular
- Durability at high speeds??

Potential advantages

- Structure may live as long as the vehicle: only treads replaced (retreaders' dream)
- Production by additive manufacturing (3D printing)
- Substantial reduction in rolling resistance
- Water in the contact patch is easily escaping through holes in tread/belt
- Exterior noise can be substantially reduced with appropriate construction
- Noise from the air cavity resonance is no issue any more
- There is no air inflation that can vary and cause higher rolling resistance
- More eco-friendly materials and less raw material needed (less rubber needed, steel may be fossil-free)
- Flatter (rectangular) tire/road contact patch, may reduce rubber wear
- May have more space for brakes, or for integrated electric motors
- Futuristic look (vehicle designers' dream)

tor 2018-01-11 13:30

TT

Tire Technology International <tiremag@tire-uki-me.com>

TTI Awards 2018: Shortlist revealed!

Till Ulf Sandberg

Följ upp.
Om meddelandet inte visas som det ska kan du klicka här för att visa det i en webbläsare.

Avbryt prenumeration

MONTHLY ONLINE POLL

VOTE

vote now!

- Yes
- No
- Tall and narrow tires will become more prevalent but traditional tires will always exist alongside

Click here to vote now!

Last month we asked which of the below technologies and trends you think will be introduced to mass-market tire production in the future? The results show...

tire technology EXPO 2020

February 25, 26, 27, 2020
Halls 19/20/21, Hannover, Germany

PANEL DISCUSSION: **The Tire Revolution**

Chair: Rudi Hein, independent tire expert (retired), VDI, Germany

Dr Hans Dorfi, director of digital engineering, Bridgestone Americas, USA

Cyrille Jean-Paul Roget, scientific and innovation communication director, Michelin, France

Prof Burkhard Wies, vice president R&D PLT replacement worldwide, Continental, Germany

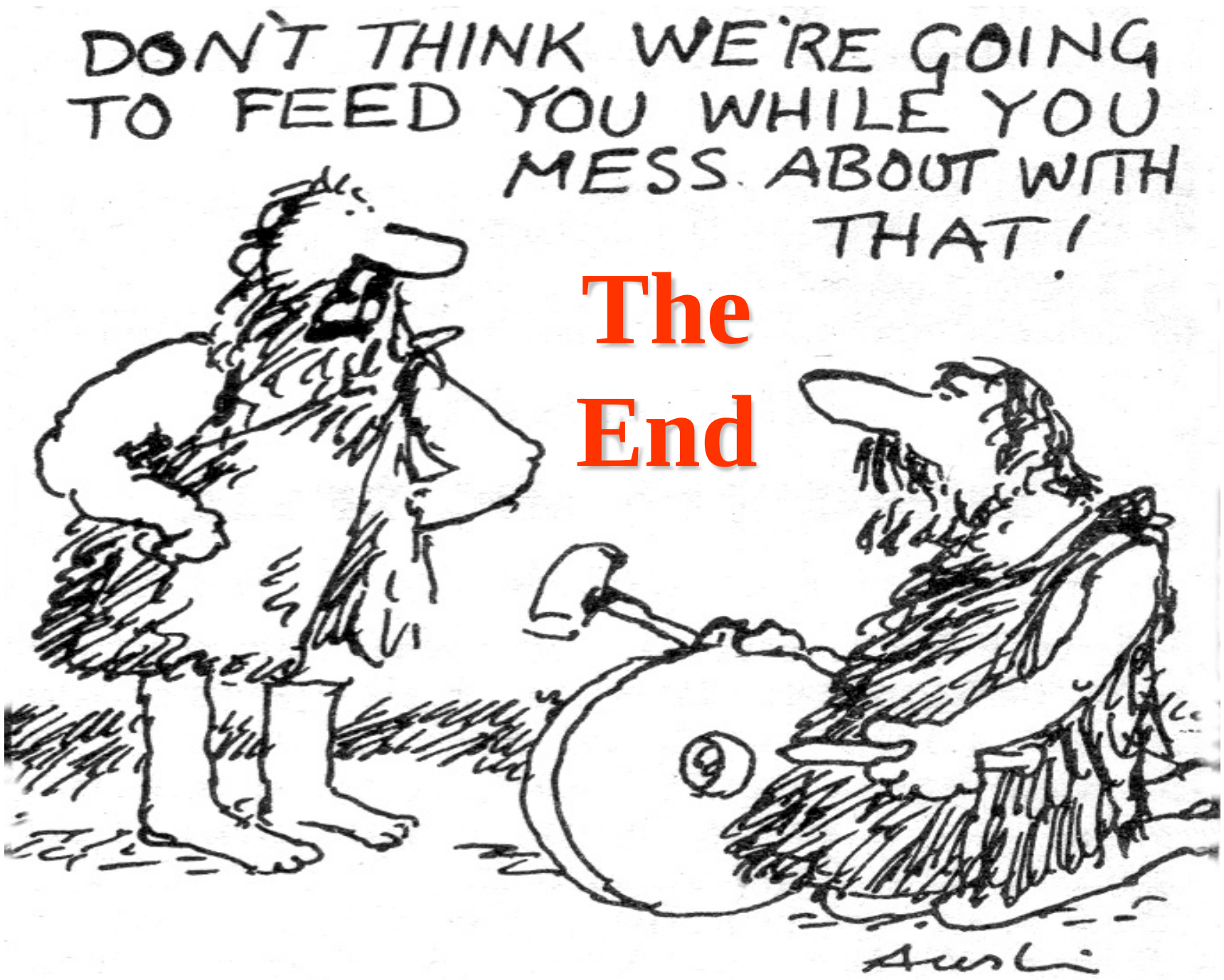
Bruce Lambillotte, vice president of technical consulting, Smithers, USA

Dr Gerald Potts, principal, GRP Dynamics LLC, USA

Question: is the airless tire the tire of the future?

Answer: all were more or less sceptical, except Mr Roget

The future of tires according to Kumho


DON'T THINK WE'RE GOING TO FEED YOU WHILE YOU MESS ABOUT WITH THAT!
The End