Hunter Rouse
Hydraulic Engineering Lecture

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Hunter Rouse Lecture
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1) My H&H dream
2) By year 2000, ...
3) We all know ...
4) Hunter Rouse and CSU ...
1) My H&H dream

“...every sediment particle which passes a cross-section must:

(1) have been eroded on the watershed; and

(2) must be transported by the flow to the cross-section...”

Hans Albert Einstein, 1964

Let's remember:
The IBM 360 needed the library basement to process 72kB of data. Today, 72GB of data fits in your pocket.
From Julien, MS thesis, 1979
Rainfall
Retention
Infiltration

**CASC2D- Julien et al. (1995)**
Jerry Richardson, PhD ‘89
Bahram Saghaian, PhD ‘92
Fred Ogden, PhD ‘92
William Doe III, PhD ‘92
Don May, PhD ‘93
Darcy Molnar, PhD ‘97

**CASC2D-SED – Johnson et al. (2000)**
Billy Johnson, PhD ‘97
Jeff Jorgeson, PhD ’99
Amit Sharma, PhD ‘00
Rosalia Rojas, PhD ‘02
TREX Model
Mark Velleux, PhD ‘05
John England, PhD ‘06
James Halgren, PhD ‘12
Jaehoon Kim, PhD ‘12
Jazuri Abdullah, PhD ‘13
CSU Watershed Model TREX

From J. Halgren, 2009
Today, we can simulate the PMP and PMF on large watersheds from Ji, Velleux, Julien, Hwang, JEM 2014.
2) By year 2000, all hydraulic problems will be solved with computers ... hm...
The original Shields Diagram, 1936, It is based on the sum of forces.

\[ F_S = F_W - F_B \sim (\gamma_s - \gamma) d_s^3 \]

From A. Shields, 1936
Hunter Rouse’s version of the Shields Diagram, 1939 - what is the difference?

From Rouse, 1939
Laboratory experiments at CSU

~10,000 particle velocity measurements

Bounvilay and Julien, ASCE-JHE (2013)
Incipient motion depends on the sum of moments, not forces. The Shields approach can only be a rough approximation.
Lets remember:
Hydraulic laboratories help us gain new knowledge that would not be possible with computers alone.
3) We all know
   a) Velocity profiles
   b) Sediment plugs
We all know ... that the maximum flow velocity is often observed below the free surface.

From ven te Chow (1959)
Theory - Modified Log-Wake Law

- The modified log-wake law
  - In 2003 and 2005, Guo and Julien proposed a modified log-wake law for turbulent pipe and boundary layer flows.

\[
\frac{u}{u_*} = \left( \frac{1}{\kappa} \ln \frac{y u_*}{v} + B \right) + \frac{2 \Pi}{\kappa} \sin^2 \frac{\pi \xi}{2} - \frac{\xi^3}{3 \kappa}
\]

- The wake strength \( II \): the effects of pressure-gradient in pipes or convective inertia in boundary layers.
- The last term corrects the log law velocity gradient to be zero at the maximum velocity.

Lets remember:
We were all excited to solve sin and cos on an HP 35.
Today spreadsheets solve erfc, gamma and Bessel functions.
... and practice

Atchafalaya River
Louisiana

Lets remember:
Can we theoretically solve the practical problems that have been waiting for so long?
Do we know how sediment plugs form?

Where did the water go?

Rio Grande
New Mexico

Photo from Baird, USBR
Rio Grande – note the channel width changes 1996-2009

1996
River Engineering

Noel Bormann, PhD ’88
Otto Stein, PhD ’90
Yongqiang Lan, PhD ’90
Gyewoon Choi, PhD ’90
Jayamurni Wargadalam, PhD ’93
Gigi Richard, PhD ’01
Suleyman Akalin, PhD ’02
Claudia Leon, PhD ’03
Un Ji, PhD ’06
Yongho Shin, PhD ’07
Kiyoung Park, PhD ’13

Let’s remember:
There is a sense of discovery when reading the ASCE-JHE
4) Hunter Rouse and CSU ...
1902 – pass or fail exam at CSU: can you walk on water?
2. Compare Euler, St-Venant, Nav-Stokes, & Reynolds, etc.

3. What is a non-Newtonian fluid?

4. What is principle of viscous lubrication?

5. [Diagram] show continuity relationship graphically

6. What is dissipation mechanism?

7. What change does a turbulent eddy undergo with time?

8. What is result of vortex stretching?

9. How can one change time scale of turbulent length scale?

10. What is difference between flow through grid and alongwall flow?
In response to a student at a weekly oral exam:
“…I have been teaching Fluid Mechanics for 50 years and this is the worst answer I ever heard…”
Hunter Rouse, 1986
Today CSU recruits the most talented students.
we subject them to rigorous training
... and recognize when they are ready to graduate.
Rising Stars!
Thank You!
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