

COMMITTEE ON EDUCATION AND THE WORKFORCE

SEPT 21, 2000



DR ALAN GREENSPAN
CHAIRMAN
FEDERAL RESERVE SYSTEM

"WE ARE IN A PERIOD --- OF RAPID INNOVATION THAT IS YIELDING CHANGES IN THE WAY GOODS & SERVICES ARE PRODUCED -- AND DELIVERED TO FINAL USERS. THESE... ARE MARKEDLY ELEVATING THE SKILL LEVELS THAT WILL BE NEEDED ... IF (WE) ARE TO FUNCTION EFFECTIVELY IN THE YEARS AHEAD. THERE MUST BE AN ONGOING DIALOGUE OF LEADERS IN BUSINESS, LABOR, EDUCATION, PUBLIC POLICY ... IF WE ARE TO BE SUCCESSFUL IN MEETING THE RISING DEMAND FOR SKILLED WORKERS. ♦ IN ORDER TO REALIZE THE POTENTIAL THAT ADVANCES IN SCIENCE AND TECHNOLOGY HAVE TO ENHANCE LIVING STANDARDS FOR A LARGE MAJORITY OF AMERICANS."



SO ENTER THE "CIVIC SCIENTIST" WHO,
LIKE SUPERMAN, MUST TAKE OFF HIS
LAB COAT, DROP HIS SIDE RULE* AND
GET INVOLVED



THE BATTLE IS FOR THE HEARTS AND
MINDS OF THE CITIZENS OF OUR NATIONS.
IT IS TO ENLIST THE POPULATIONS IN THIS
COMPLEX SET OF ISSUES THAT CONNECT OUR
SCIENTIFIC THINKING AND CAPABILITIES TO
THE PHYSICAL, SOCIAL AND MORAL PROBLEMS
THAT HUMAN CIVILIZATION FACES.

THE WAR IS A WAR AGAINST IGNORANCE
ITS BATTLE GROUNDS ARE THE SCHOOLS
OF THE NATION

* Side rule

THE PURPOSE OF SCHOOLS (MY OPINION)

IS TO PRODUCE GRADUATES WHO CAN
MANAGE* AND THRIVE IN THE WORLD
INTO WHICH THEY EMERGE

BUT THAT WORLD IS CHANGING

(IT IS NOT THE WORLD OF THE TEACHERS,
PARENTS, SCHOOL OFFICIALS, EVEN OF
PRESIDENT CLINTON..)

* THEY MUST OF COURSE MANAGE THEIR
OWN LIVES BUT ALSO PLAY A ROLE IN
DECIDING HOW THE CITY, THE STATE AND
THE NATION WILL USE THE POTENTIAL
OF THE AWESOME NEW TECHNOLOGIES :

FOR THE BENEFIT OF HUMANITY
(BUDAPEST: WCS)

OR

FOR CREED AND FEAR



SO, THERE IS A PROBLEM. HERE IS
ONE REASON WHY:

TODAY (FEB 2001) IN 99% OF ALL
US HIGH SCHOOLS, STUDENTS
STUDY SCIENCE IN THE FOLLOWING
SEQUENCE:



BIOLOGY	IN NINTH GRADE	~100%
CHEMISTRY	IN TENTH GRADE	50%
PHYSICS	IN ELEVENTH GRADE	22%

WITH LITTLE OR NO CONNECTIONS

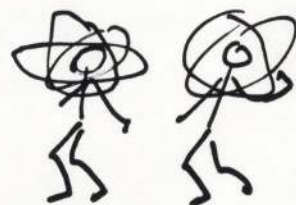
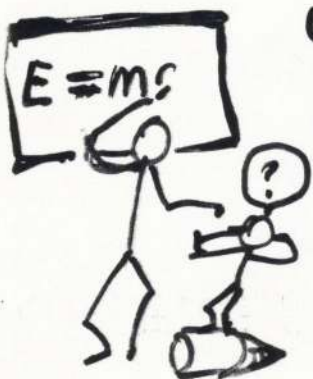
- THIS SEQUENCE WAS DEVISED IN 1893 BY A "COMMITTEE OF TEN" COMMISSIONED TO STANDARDIZE THE HS SCIENCE CURRICULUM.

- OK IN 1893
- OUT OF DATE IN 1960
- DISASTER TODAY

- NINTH GRADE BIOLOGY HAS MORE NEW WORDS THAN 9TH + 10TH GRADE FRENCH

TO BE BLUNT AND ONLY
SLIGHTLY SIMPLISTIC, WE ASSERT

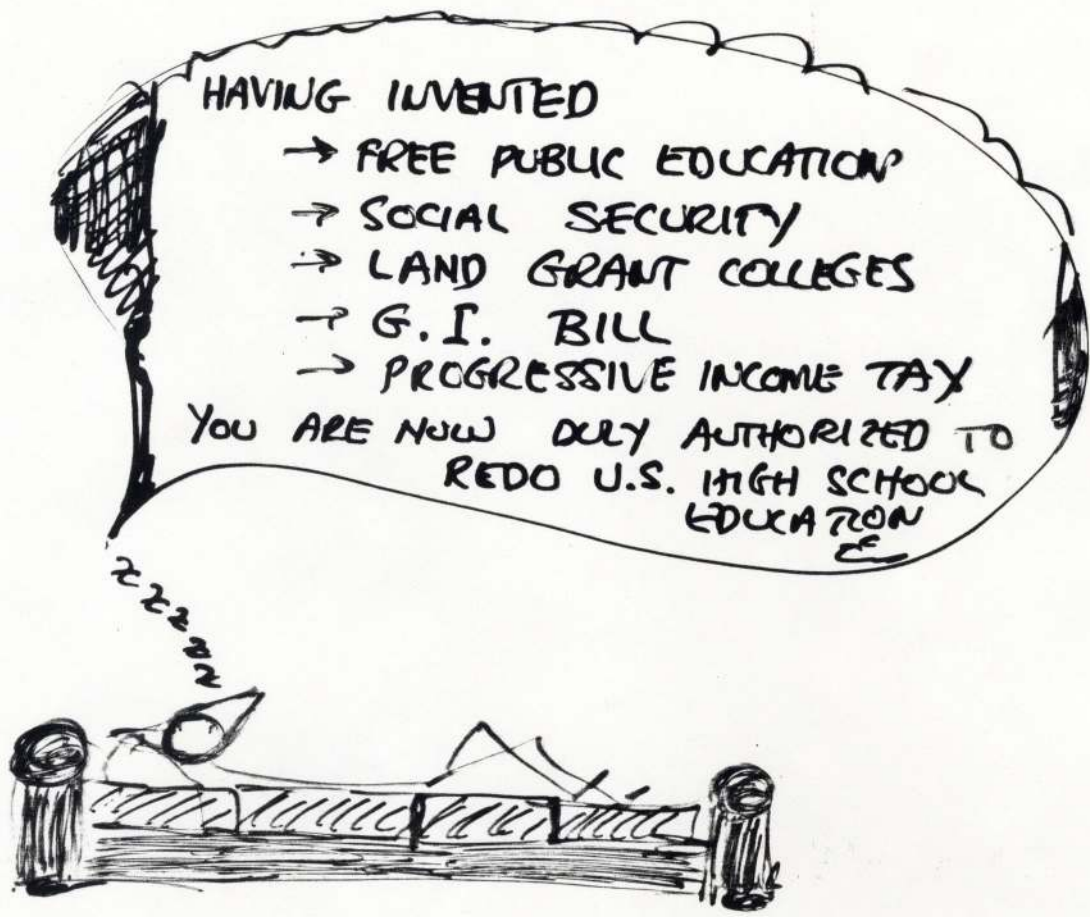
▶ THE AVERAGE H.S. STUDENT CANNOT
POSSIBLY UNDERSTAND* CHEMISTRY
WITHOUT HAVING STUDIED PHYSICS
AND ITS ATOMS



THE AVERAGE H.S. STUDENT CANNOT
POSSIBLY UNDERSTAND MODERN
BIOLOGY WITH CELLS, GENES, DNA
WITHOUT HAVING STUDIED PHYSICS
AND CHEMISTRY

▶ TO CARRY AWAY THE ART OF SCIENCE
THINKING, WE MUST INVEST LOTS OF
TIME IN HOW SCIENCE WORKS, ITS
PROCESSES, ITS HISTORY, WHAT IT
CAN AND CANNOT DO

TEACHING FOR UNDERSTANDING - HOWARD GARDNER

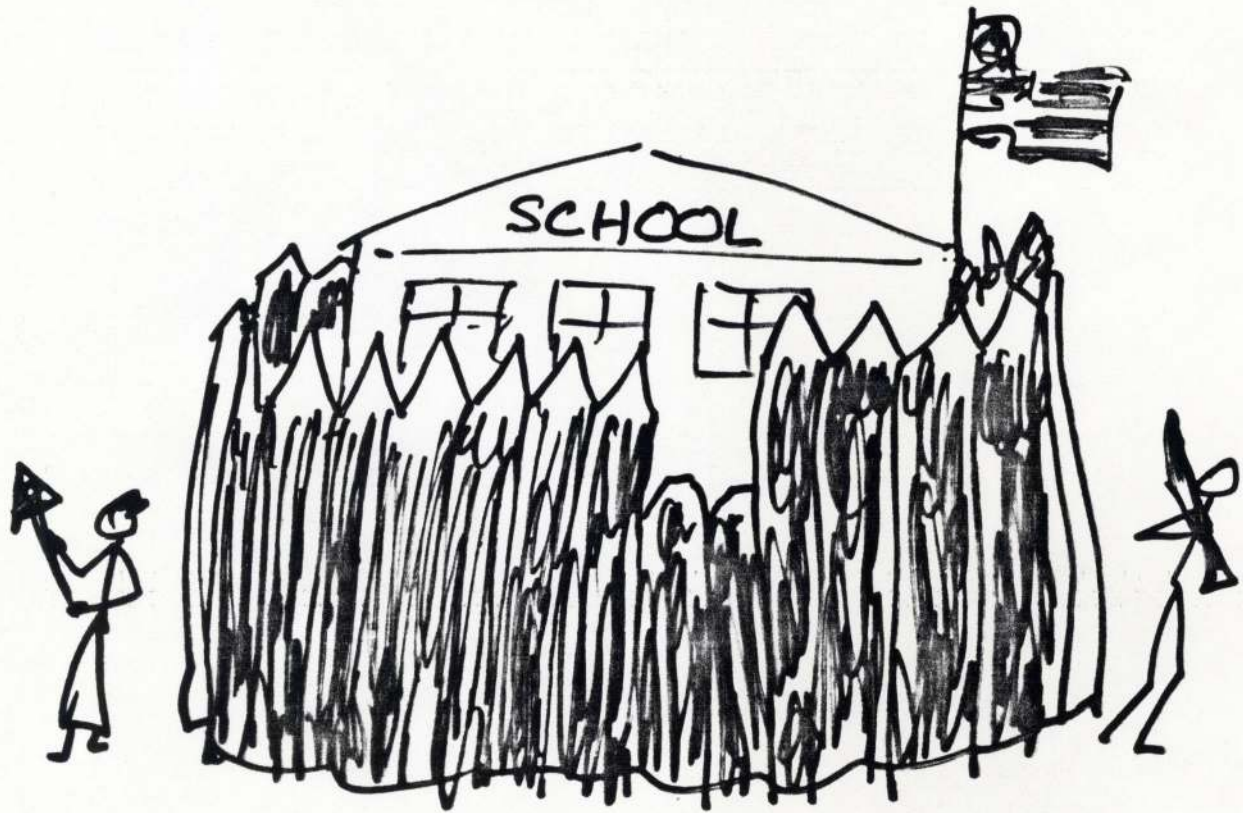


HAVING INVENTED

- FREE PUBLIC EDUCATION
- SOCIAL SECURITY
- LAND GRANT COLLEGES
- G.I. BILL
- PROGRESSIVE INCOME TAX

YOU ARE NOW DULY AUTHORIZED TO
REDO U.S. HIGH SCHOOL
EDUCATION

DREAMS OF GREATNESS



NO CHANGES!
PARENTS
TEACHERS
PRINCIPALS
TEXT BOOK
PUBL.
LEGISLATORS



"HE SAYS THERE IS A
WEAK POINT AT
NINTH GRADE BIOLOGY"



THE PERIODIC TABLE OF THE ELEMENTS 1900

H ¹	He ²						
Li ³	Be ⁴	B ⁵	C ⁶	N ⁷	O ⁸	F ⁹	Ne ¹⁰
Na ¹¹	Mg ¹²	~~~~~					U ⁹²



THE STANDARD MODEL OF PARTICLE PHYSICS 2000

" FLAVORS "	I	II	III	} QUARKS
	u	c	t	
SLOBURY 2000 →	d	s	b	} LEPTONS
	e	μ	τ	
	ν _e	ν _μ	ν _τ	

AND THE FORCES OF NATURE			
EM -	CARRIED BY	PHOTONS	
STRONG	" "	GLUONS	
WEAK	" "	W ⁺ W ⁻ Z ⁰	
GRAVITY	" "	GRAVITONS ?	

THE METAPHOR OF THE LIBRARY



BOOKS
CHAPTERS
PARAGRAPHS
SENTENCES
WORDS!

A BRIEF HISTORY OF THE NEUTRINO

WOLFGANG PAULI'S "DESPERATE CONJECTURE" (1934)

• START
A RADIOACTIVE NUCLEUS
SITS THERE ... WAITING



$$\text{ENERGY } Mc^2 = 6 \text{ (SIX)}$$

• END
AN EXPLOSION
AND THEN, A PIECE
OF A NUCLEUS
AND A SPEEDING
ELECTRON



$$\text{ENERGY } mc^2 + E_e = 5 \text{ (FIVE)}$$

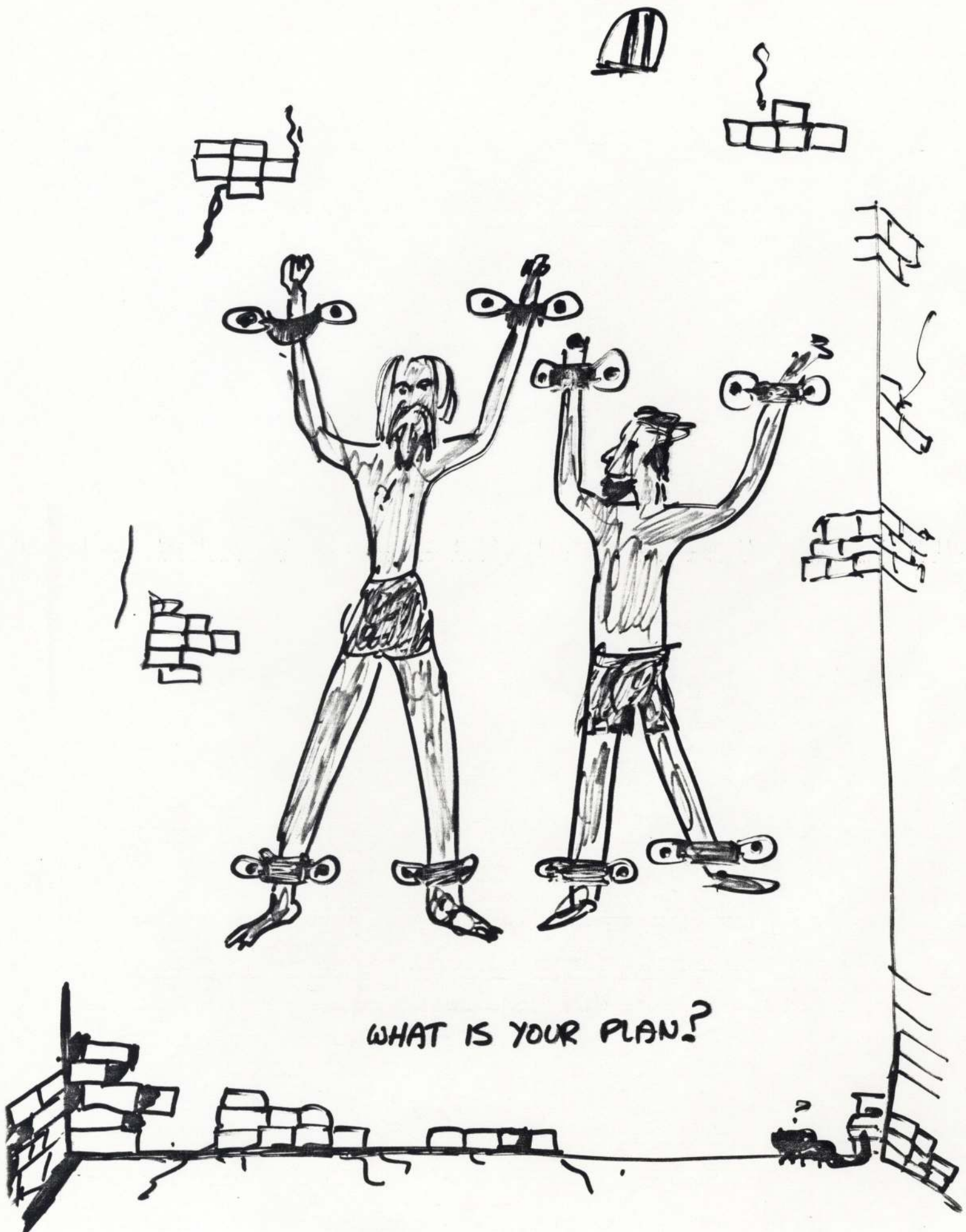
PAULI: "FIVE IS LESS THAN SIX!"

IT CAN'T BE! ACH, I WISH
I AM DEAD, WHY DID I
GO INTO PHYSICS?"

• THEN
PAULI HAS AN IDEA:
A "SMALL NEUTRAL THING"
TAKES AWAY THE ENERGY

ENRICO FERMI SAYS "CALL IT NEUTRINO"





WHAT IS YOUR PLAN?