

## Brave new science?

### Changing perceptions, attitudes and interests in S&T

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## Growing Ambivalence: The two faces of S&T

1. S&T in the service of the good; saving lives, improving material conditions, providing knowledge, pushing back ignorance and superstition, providing insight, wisdom and cultural values.
  2. But also:  
Providing tools for oppression and material and cultural domination, means for the exploitation of nature and weapons for mass destruction.
- As always ...?



## Recent challenges for S&T

- S&T as driving the economy
- Markets, 'security' and military as 'decision makers': Neglect of real human needs?
- Global priorities: 'survival of the ... richest'
- Eroding and changing ideals: farewell to objectivity and neutrality?
- "No ethics, please – we're scientists"
- School S&T as fossils? (Positivism is dead – but won't lie down)
- S&T under attack: Feminist, Cultural and Postmodernists' critiques, Western science? WASP science? ...
- "Science War" from social scientists: Progressive or reactionary?
- How progressive is the celebration of 'ethno-science' and of 'localizing' science?

## Brave New Science? Changes S&T and its relation to society

### Witnesses:

1. **Eric Hobsbawm** (historian)
2. **John Ziman** (physicist, later science policy analyst)

## Witness 1: Eric Hobsbawm:

- The historical transition of science:
- From radical, antiauthoritarian rebel in the pre-war period
- To current loyal, conservative
- On payroll from Industry and Military
- Acting in the interest of dominant powers.



## Pre-war science: The scientist as intellectual hero and rebel

### • Intellectual hero:

"To be a scientist was to be envied. Certainly those of us who were students in Cambridge [...] knew what we had wanted to study, *if* our mathematics had been good enough!"

### • Radical rebel:

"The typical British scientist of the 1930s was a member of the (Left-wing) Cambridge Scientists Anti-War Group ... their distinctions ranged from the Royal Society to the Nobel price..."  
(Eric Hobsbawm, *The Age of Extremes* 1996 (p 543) )

## Changing times, changing ideologies and commitment...

### Some decades later:

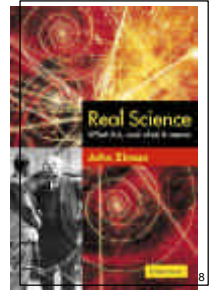
- “The political temperature of science dropped after the Second World War. Radicalism in the laboratories receded rapidly...”
- “The generous support ...encouraged a breed of researchers who took their paymaster's policies for granted and preferred not to think about the wider implications of their work, especially when these were military. (Hobsbawm 1996)

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## Witness 2: John Ziman:



- The narrow specialization of scientists
- The (increased) need for ethics and social responsibility
- Eroding ethos and ideals?
- Farewell to scientific objectivity?
- From critical, radical and antiauthoritarian – to accepting, conservative and complacent
- Transition from **academic** to **post-academic science**



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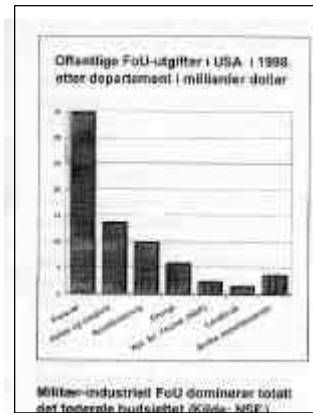
## Strange New World: Current priorities

- **NASA:** Budgets larger than 20 African State budgets during Cold War
- New enemies – new budget increases!
- **NOKIA:** Higher R&D budget that all R&D in Sub-Saharan Africa
- **Nike:** More spending on R&D for shoe soles than the world's spending on malaria research
- **Gillette:** 750 mill USD on the development of Mach3 (New razor blades to replace Mach2!)
- April 2003: 650 Billion \$ to War on Iraq. (6,5 % of the US GDP – only 0,23 % for development aid)
- US annual private spending 400 Billion \$ on “fight against fat” -- Similar spending on pet (dog, cat) food

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## Funding of research in the US ...

Mainly from **Defence**, only 2% from NSF (National Science Foundation)



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## “Science, Money and Politics”

- Big Science, techno-science (NASA, CERN, HUGO..)
- Over-national and multinational
- Governed by 'external' forces: economy, politics, military, industry ...
- Efficient lobbies for ever increasing budgets...
- “Political Triumph and Ethical Erosion”

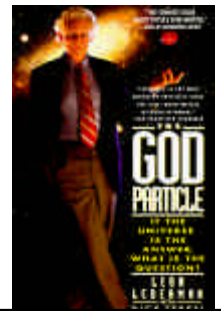


Science: Single-minded pursuit of money (Greensberg 2002) 11

## The ambitions of Science

(Fascinating for some – frightening for others?)

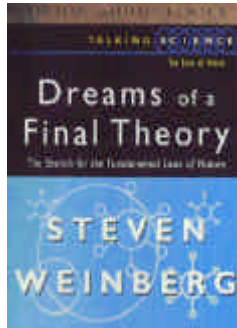
- **Physics:** “The Theory of Everything”
- The hunt for “The God Particle” (Leon Lederman, Nobel laureate)



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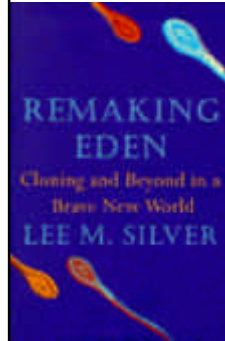
## “Dreams of a Final Theory”

- “Weinberg, the 1979 Nobel Prize-winner in physics ..
- ...tells the story of a great intellectual adventure of our time: the search for nature’s *final* laws and *the final answer* to our questions about why nature is the way it is.
- ... a defence of *reductionism* ....”



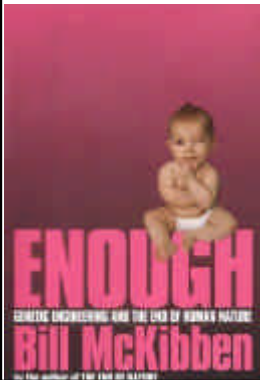
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**Concern also about Biology:**  
”Remaking Eden -  
- Cloning and Beyond in a Brave New World



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## Enough: Genetic Engineering and the End of Human Nature



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## The views of “the public” and students?

- How widespread is the concern?
- Opinion polls and surveys give food for thought ....
- One example follows...

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## Europeans, Science and Technology

Eurobarometer 55.2 (2001)  
(one of many surveys)

New 2003: Including 13 potential member states

- S&T related interest and knowledge
- Values, science, technology
- Responsibilities and accountability of scientists
- **New, revised study planned for 2005 (incl US and Japan)**



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## Attitudes to science (EU 2001)



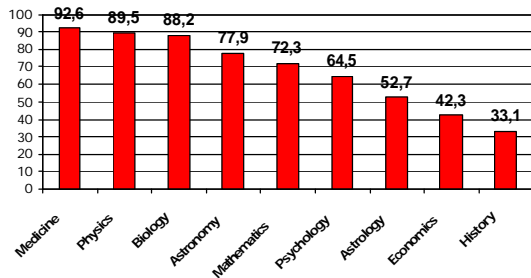
- **“Science is changing our ways of life too quickly”**  
Agree: 61.3%
- **“Scientists’ knowledge gives them a power which makes them dangerous”**  
Agree: 63.2%
- **“The authorities ought to formally oblige scientists to observe ethical rules.”**  
Agree: 80.3%

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## Science versus non-science



For each of the following disciplines, please indicate whether it appears to you rather scientific or not very scientific.

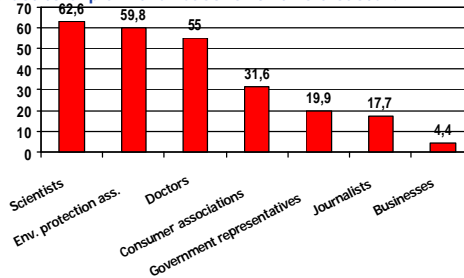


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## Trust in different groups and occupations



Imagine that there has been a disaster in your neighbourhood or district. Who would you most trust to explain the reasons for this disaster?



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## Engineers and scientists: No more heroes?

In all Boys' rooms in Norway:  
*The Adventures of Engineer Knut Berg*



Last issue came in 1960

## Changing ideas about S&T. Norwegian textbooks as an illustration

- In Norway (until 2000): Official ministerial scrutiny of textbooks
- Hence: Textbooks may illustrate politically correct ideologies
- The changing image of S&T

## Science textbooks in the 60's and early 70's: Optimisms and steady progress



Kemiske stoffer skal jordes  
utvikling, og traktorer lette  
arbeidet.

**Chemicals increase the yield,  
machines make work easier**

Bilder fra Aifsen og Wang-Lund:  
*Naturfag for grunnskolen, 7,8 og 9. skoleår,*  
Gyldendal 1973



Effektive sprengstoff og store  
arbeidsmaskiner gjør det mulig  
å bygge veier og jernbaner.

**Efficient explosives and large machines  
make it possible to build roads and railways**

Opstil på lægemiddelkøbet om-  
 stalt er det gjort mere for-  
 nemt, inden lægemiddelen,  
 apotekerne nu til enhver tid  
 selger os de beste-mediciner.



**Also in pharmacy there is great progress.  
 The pharmacies must always provide us  
 with the best medicines**

Also a mirror of gender roles of its time

Modern vaskemiddel er et  
 rigtig produkt for organisk  
 kjemisk industri.



**Modern washing powder is an important  
 product of organic chemistry**

Modernes kjemiske stoffer gør  
 jule-ture også lettere til at  
 gøre en behagelig ferie og tilid.



**Modern chemical materials can also give  
 us comfortable leisure and spare time**

Godt lys er nødvendig når du  
 laver lektier. En elektrisk belys-  
 ning er god til det.



**Good light is necessary for doing homework.  
 An electric stove is great for cooking.**

I vaskerierne bliver strøm-  
 men rigtig brugt.



**In the laundries,  
 the electricity is doing useful work**

## Gradually: a concern about the Environment and side effects of S&T

- "Silent spring" 1962, Rachel Carson.
- "Limits to Growth" (1972)
- Oil crisis 1973
- Three Mile Island Accident (1979)
- Bhopal (1984)
- Chernobyl (1986)
- Exxon Valdez (1989)
- "Population bomb"
- Global warming, depletion of ozone layer ...

New ideologies become politically correct...

Also in textbooks

UN Population conference 1974



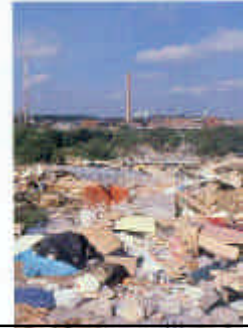
## Shifting worldview in Norwegian textbooks: The curses of industry

Hvis forurensningene fortsetter, kan det bli vanskeligere og dyrere å bygge nye og utvidelse av de gamle vannkraftverkene.

### Katastrofer

Det handler om katastrofer som ras, jordskjelvet, jordskjelvet, orkan og tyfon, fjell eller ras, forurensning av naturen og ødeleggelse av dyrene i naturen. I vårt land er det ikke noe menneskelig eller naturleg som i naturen ødelegges. Det er jordskjelvet, ras, tyfon, orkan, jordskjelvet i havet, og menneskelig ødeleggelse av naturen.

[...] *The greatest destructions in our ecological house is caused by humans. Poison in the soil, dangerous chemicals in the oceans, radioactive fallout threaten life...*



The 'new' textbook worldview  
The curse of industry – the Harmony of Nature



## The worldview of primary school science (from the mid 70's..)



*Oil spills can give awful pollution. Fish can be damaged.*



*Lead is falling down because there is lead in the smoke from planes and cars.*



*Radioactivity can be spread with the wind after bomb tests and accidents with power plants*



**Poison used against diseases can kill other plants and animals**



**Dirty sewage can pollute plants and animal life**

**46 FORGIFTING AV NATUREN**



**Many factories burn oil and coal. In the smoke there is sulphur that makes the water sour and kills the forest**

**Concern and worry also by (some) students "Scientists at work" Drawings from the SAS-study (Science And Scientists) Written report available and at <http://folk.uio.no/sveinsj>**



**A scientist at work**

**Boy from Norway, 13 year (SAS-study)**



**A scientist at work**

(Boy from Norway, 13 years)

**"I think they experiment with animals and kill them. And then they develop poisonous gases and atomic bombs"**



## Girl, Norway

- They try to invent new things to kill people or to help people



## Boy, Norway

- They research on things that they think may help or destroy the world.



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## Girl, Norway

- They are putting mice's ears on people, and they open people's heads.



## Girl, Norway

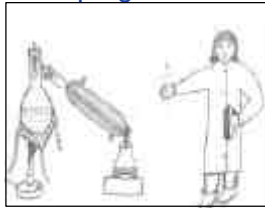
- I think that researchers often are bored at work. Making a lot of lectures and talks etc.



## Scientists at work: Developing countries



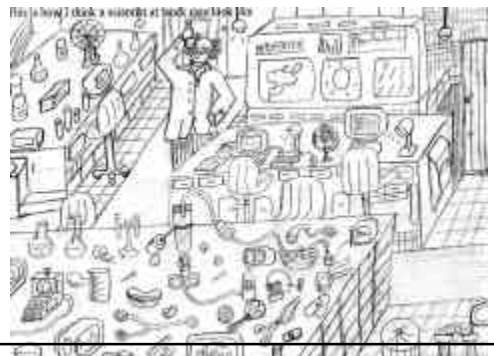
1. They are always thinking
2. They always have ideas
3. They (most) are brilliant people.
- 4 They are always making experiments new discoveries
5. If scientists were not here we ordinary people wouldn't know anything. (Girl Trinidad)



Scientists helps people regain their health. They help those that are sick or ill to get well. They are fund of discoveries. They are also kept in the hospital to take care of those that are not healthy. (Girl, Nigeria)

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## Boy, Uganda



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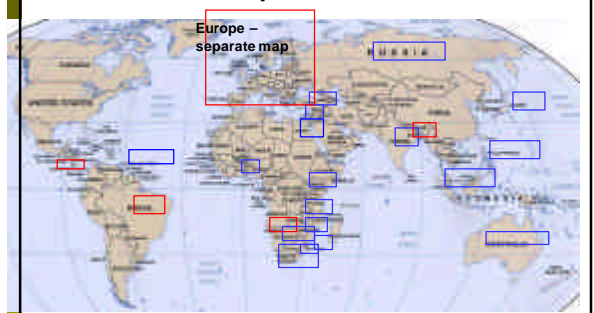
## Pupils' choices: Key factors

- Even very able pupils opt out of S&T – in particular girls!
- Young people do *not* choose S&T careers because it is good for the national economy!
- But make choices based on their own values, motifs, interests and 'self realization'.
- Pupils' **emotions**: interests, attitudes, values, future plans, perceptions of S&T, prior experience with school science
- **Relevance** (personal, social etc.)



Collected data  
Not finished (or uncertain)

## ROSE countries September 2004



## ROSE Europe – September 2004

Denmark  
Cyprus  
England  
Estonia  
Finland  
Germany  
Greece  
Iceland  
Ireland  
Israel  
Italy  
Latvia  
Northern Ireland  
Norway  
Poland  
Portugal  
Russia  
Slovakia  
Spain (Balears\*)  
Sweden  
Turkey

Collected data  
Not finished (or uncertain)



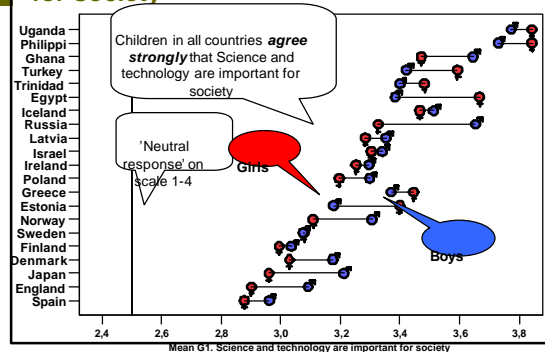
## ROSE Background and rationale Guiding principles and philosophy

1. The challenges of science education are not primarily cognitive -- but affective, related to emotions, motivation, search for meaning and **relevance** – and the pupils' need to be taken seriously
2. Science curricula (in compulsory education for all) should *not* strive towards common, universal standards – but should be adopted to cultural, local needs and values
3. Pupils' perspectives are often neglected when curricula are decided – but should play a key role
4. But children are *different* (between nations and cultures, urban/rural, girl/boy etc.)
5. There is a need for international debates on these issues, based on **theoretical reflection** and **empirical evidence**

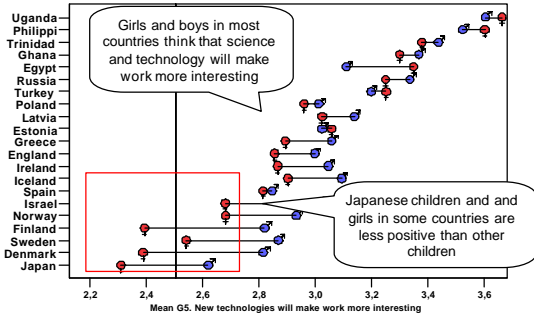
## ROSE Questionnaire: 7 Item groups

- In total 208 items, all on a 4-point Likert scale:
  - Disagree – Agree
  - Never - Often
- *My out-of-school experiences*
- *What I want to learn about*
- *My future job*
- *Me and the environment*
- *My science classes*
- *My opinions about science and technology*
- *Myself as a scientist* (Open written response)

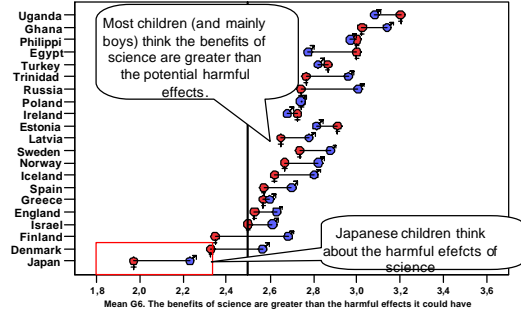
## "Science and technology are important for society"



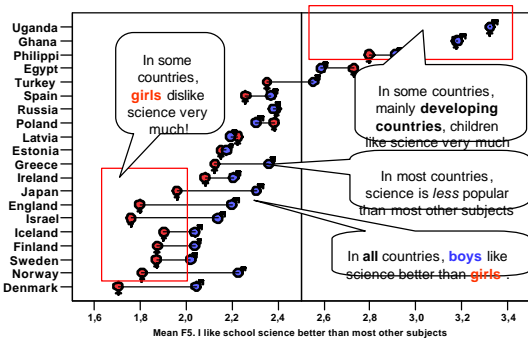
## "New technologies will make work more interesting"



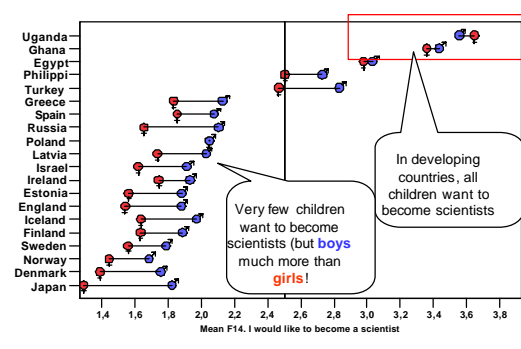
## "The benefits of science are greater than the harmful effects it could have"



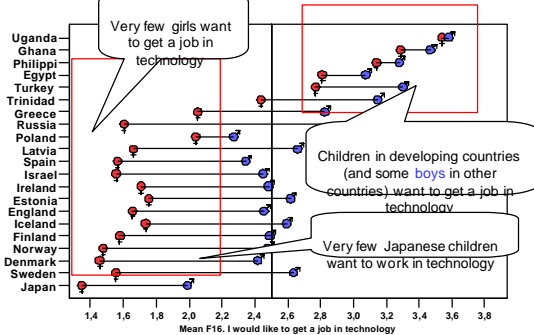
## "I like school science better than most other subjects"



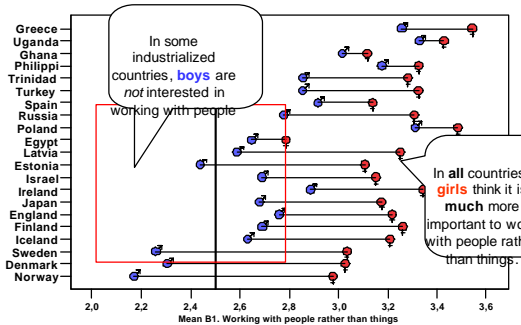
## "I would like to become a scientist"



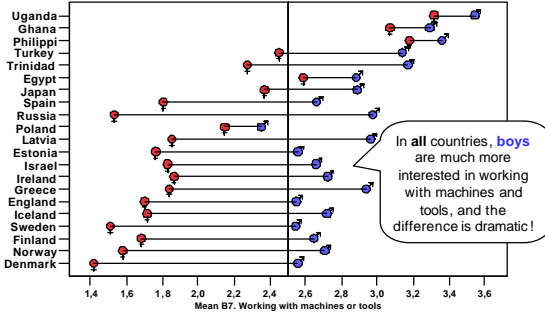
## "I would like to get a job in technology"



## Important for future job: "Working with people rather than things"



## Important for future job: "Working with machines or tools"



## Positive trends: Science and Society A priority for EU's FP6

<http://www.cordis.lu/rtd2002/>

*"Advances in science drive European growth, but sometimes give rise to fears and skepticism among citizens. The European Commission is determined to bridge the gap between the scientific community and society at large."*



## Science and Society

<http://www.cordis.lu/rtd2002/>

Science and Ethics  
Science and Gender  
Dialogue between Science and the Public  
Science Education

