

Universitat Politecnica de Catalunya

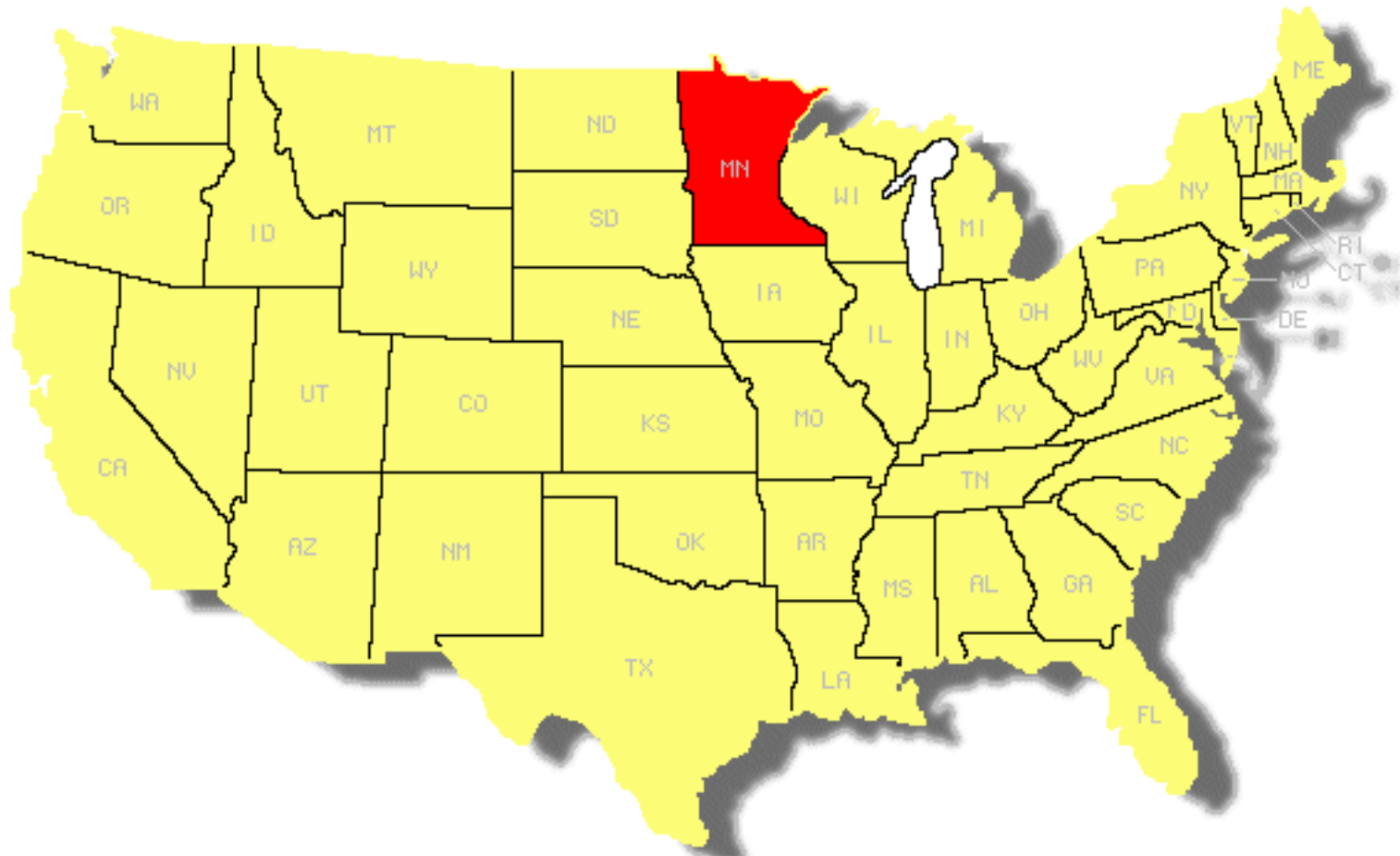
May 21, 2009

**DESIGNING NEW
CHEMICAL PRODUCTS**

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Where is Minnesota, Anyway?



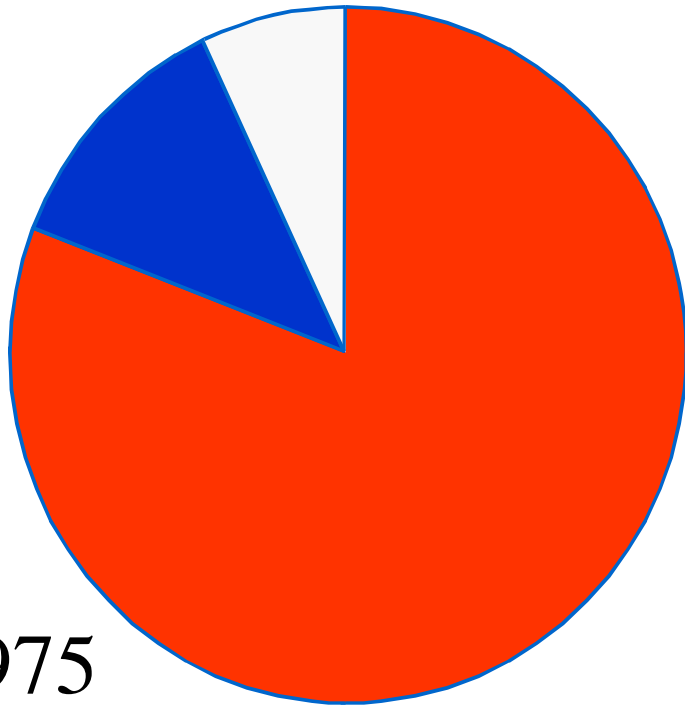
Chemicals: Fast Growth Has Ended

Textile Fiber Production (10^6 lbs/year)

	1949	1969	1989
Cotton, Wool ...	4353	4285	4794
Synthetics	92	3480	8612

Sources: Spitz, Stat. Abst., Chem. Econ. Hnbk

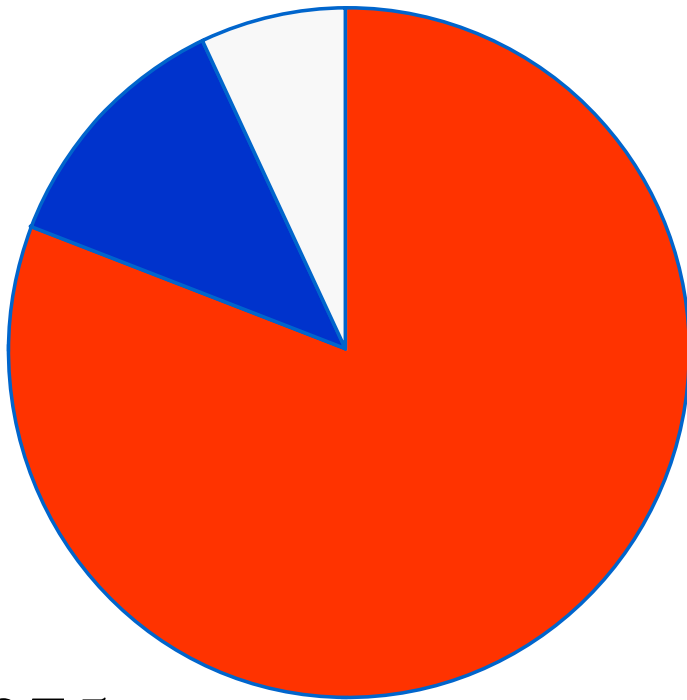
Where the Jobs Were



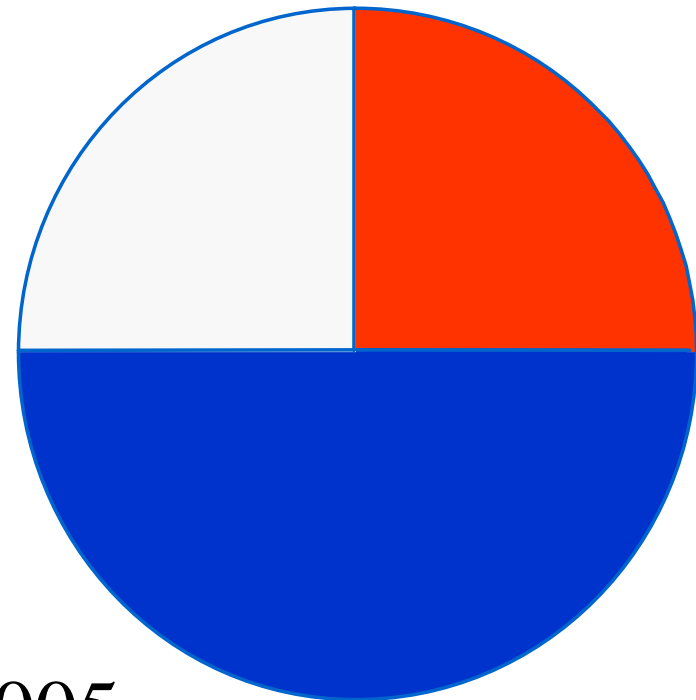
1975



Where the Jobs Are



1975



2005



What Are Chemical Products?

Commodities

Molecules

Microstructures

Key

Cost

Speed

Function

Basis

Risk

ROGER BANNISTER: SPORTSMAN OF THE YEAR

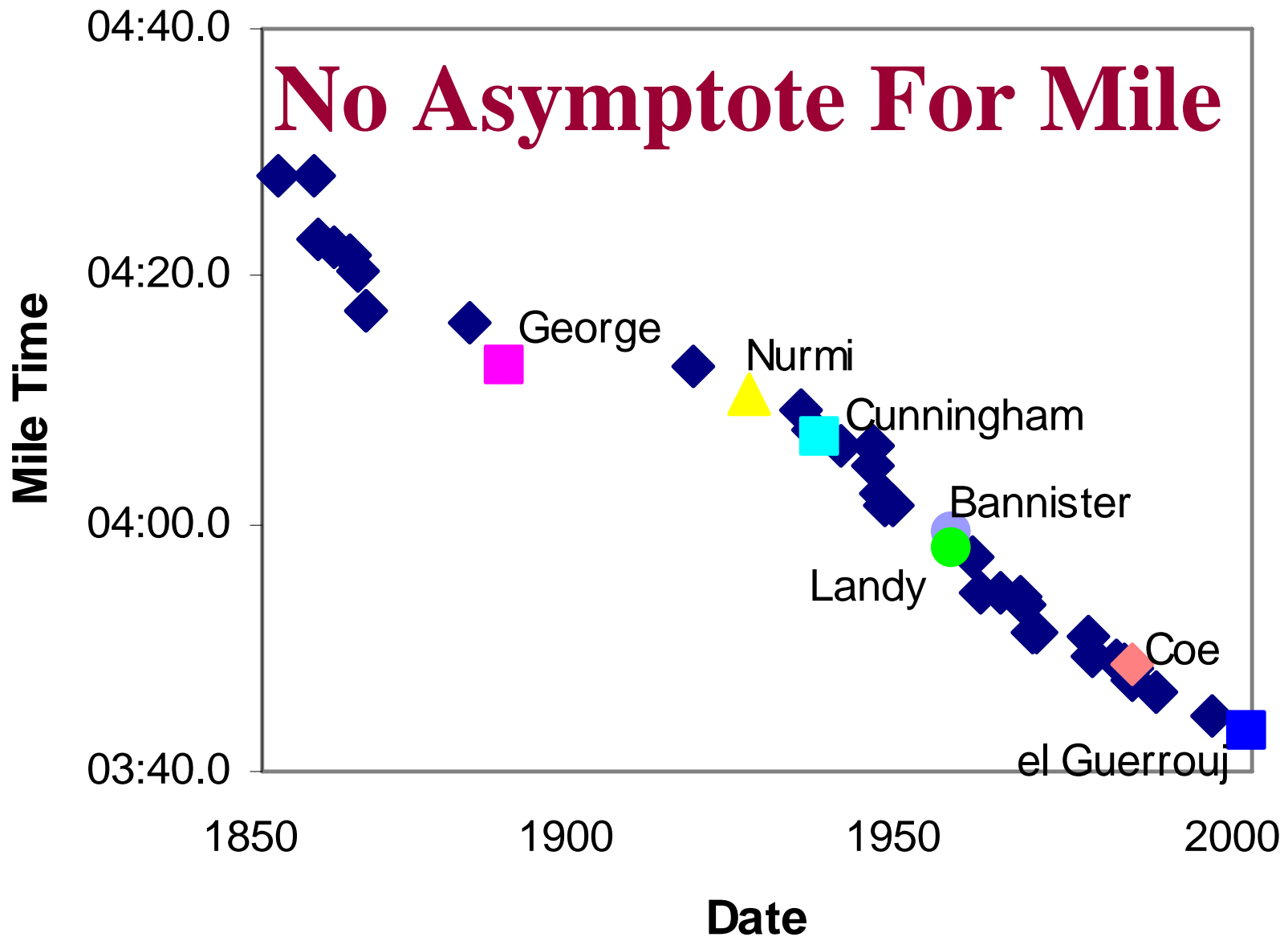
SPORTS

ILLUSTRATED

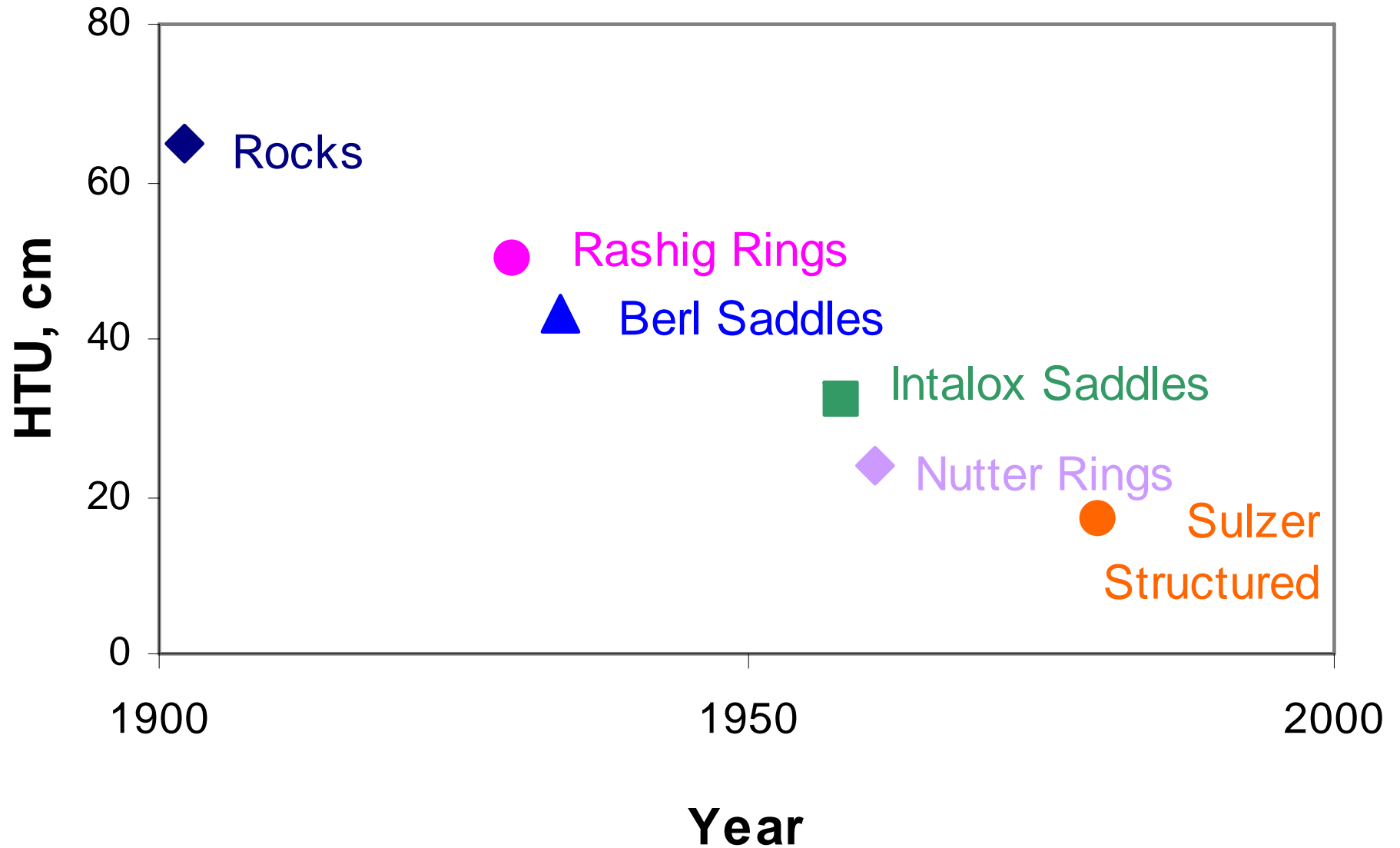


JANUARY 3, 1955

10 CENTS



No Asymptote for Commodities





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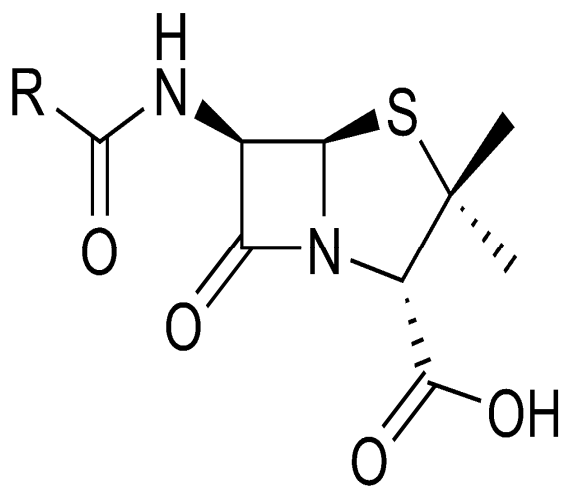
Basis

Unit Ops

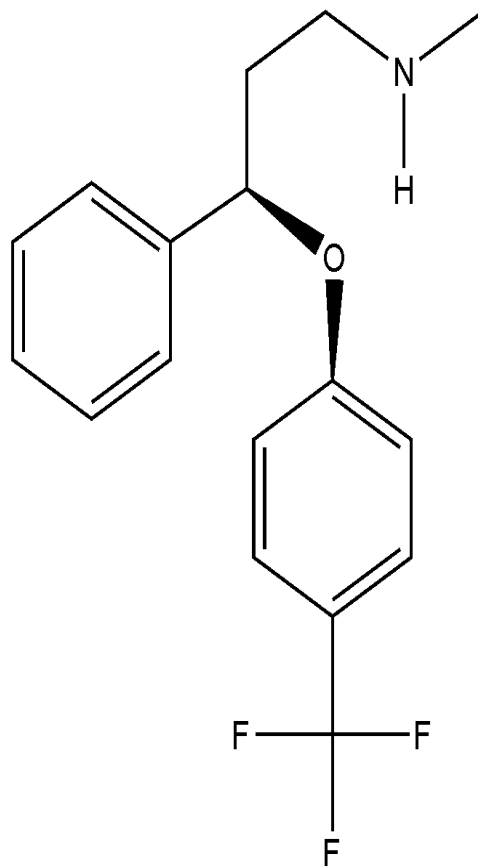
Risk

Feedstock

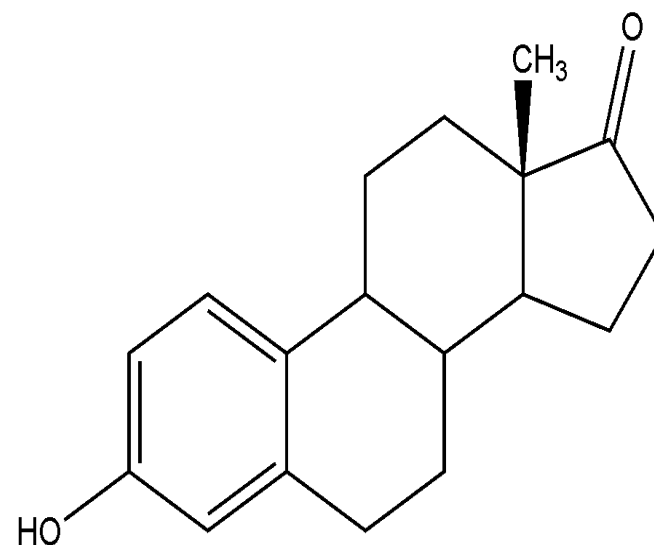
Molecular Products: Drugs



a) Penicillin

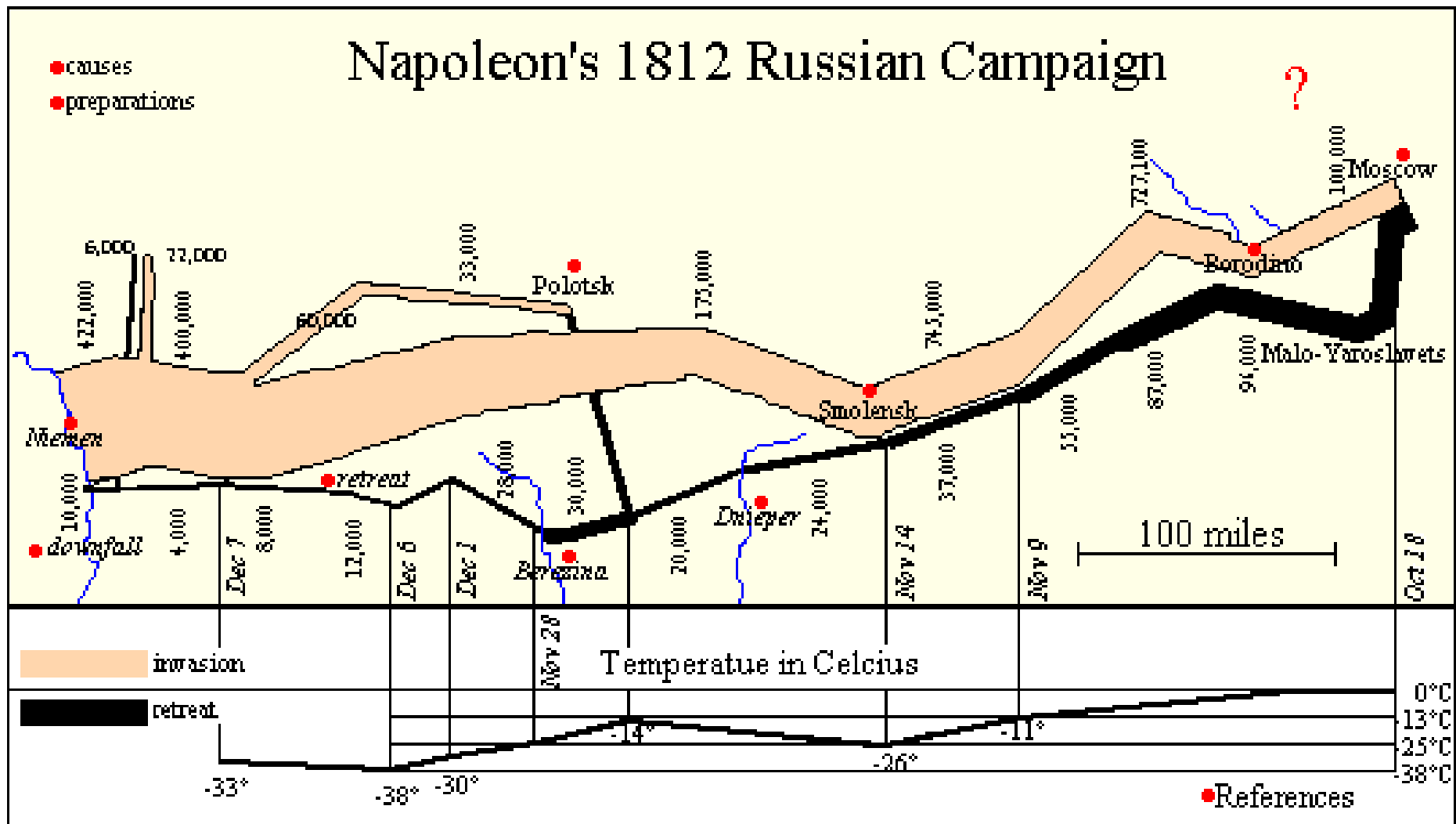


b) Prozac



c) Premarin

Molecular Products = Napoleon in Russia



What Are Products?

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Unit Ops

Chemistry

Risk

Feedstock

Discovery

Microstructures: Tooth Whiteners



Microstructure Studies Estranged



What Are Chemical Products?

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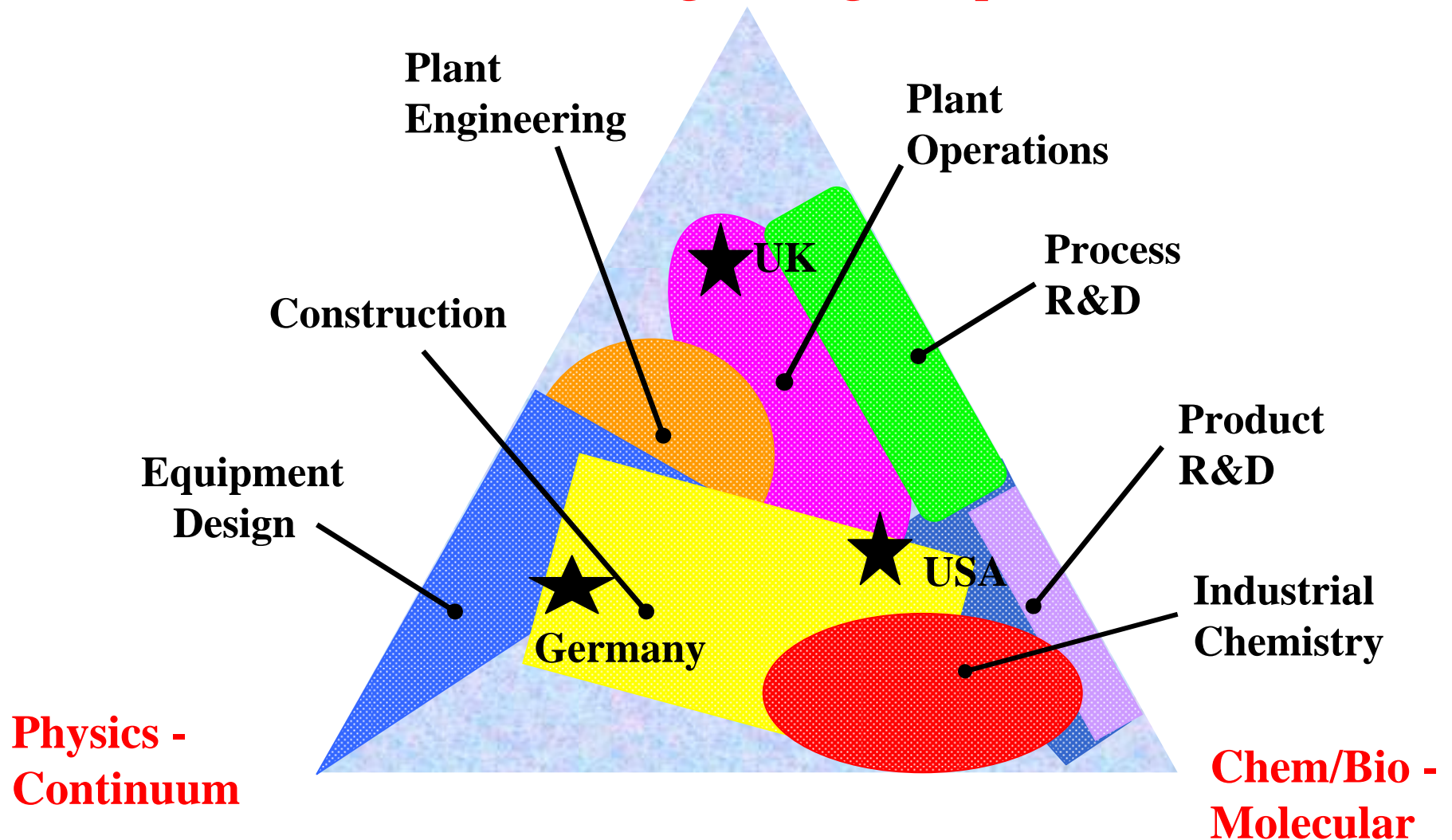
Discovery

Science

Skills Required?

Current Skill Set is Good

Chemical Engineering - Empirical



Process Skills: How to Make?

Process Design

1. batch vs. continuous
2. input/output
3. recycles
4. separation/heat

Product Skills: What to Make?

Process Design

1. batch vs. continuous
2. input/output
3. recycles
4. separation/heat

Product Design

1. customer need
2. idea generation
3. selection
4. manufacture

1. Needs

Reformed as specifications





1. Needs

2. Ideas

How many frogs must you kiss . . .

1. Needs

2. Ideas

3. Selection

Cheapest isn't always best....



1. Needs

2. Ideas

3. Selection

4. Manufacture

Which Design Step is Hardest?

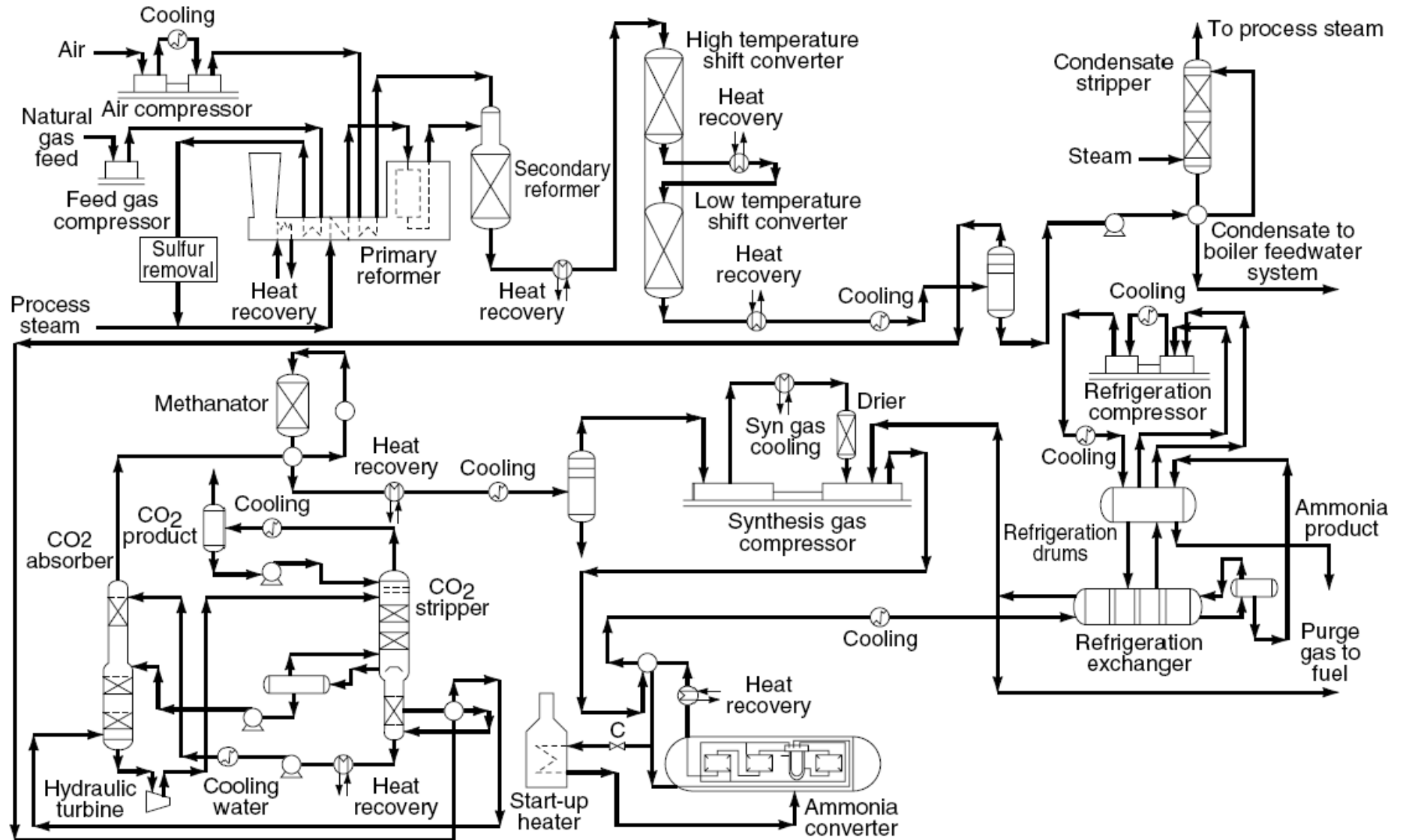
Process Design

1. batch vs. continuous
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Product Design

1. customer need
2. idea generation
3. selection
4. manufacture

For Commodities, “Manufacture” is Key

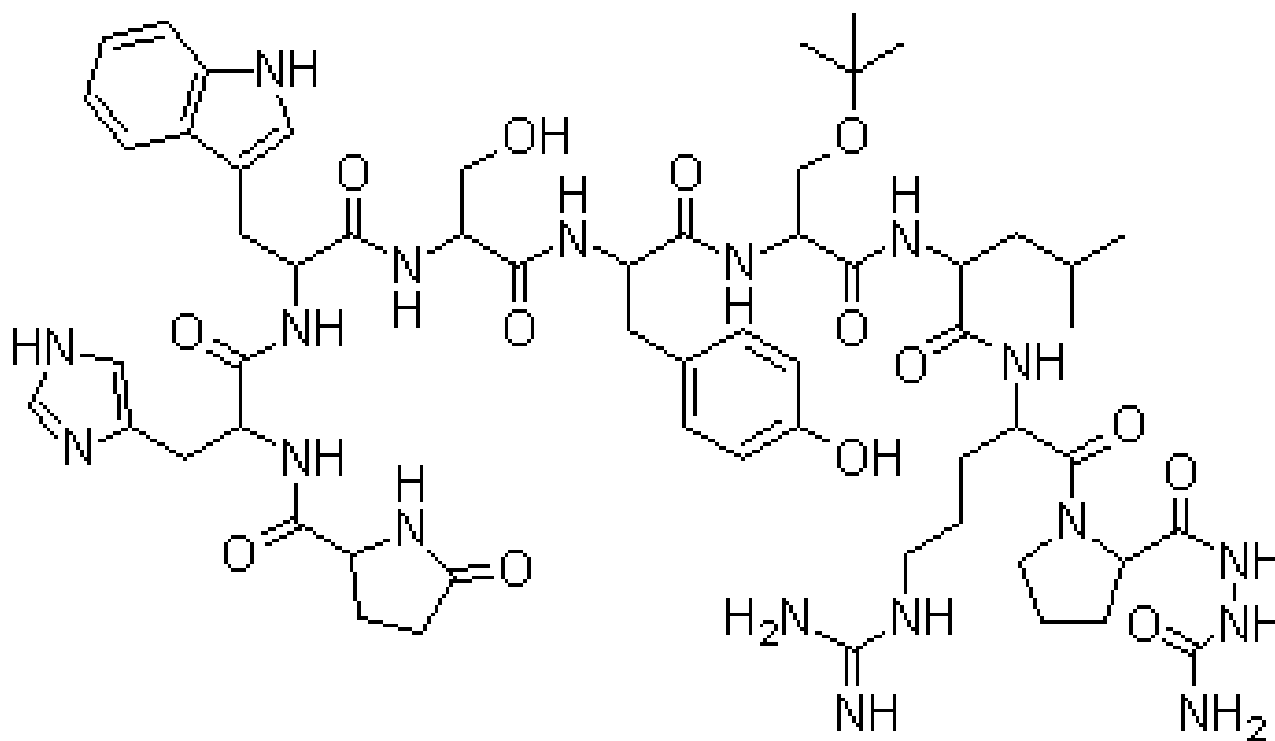


For Devices, “Selection” is Key



For Molecules, “Discovery” is Key

46 Kilos = \$800M



Pyr-His-Trp-Ser-Tyr-D-Ser(tBu)-Leu-Arg-Pro-Azagly-NH₂

For Microstructures, “Needs” is Key



Microstructure Science Incomplete

Stimuli

Sensation

Perception

Vision

Spectra

Wavelengths

Color

Touch

Food, Cloth

Forces

Texture

Taste,
Smell

Chemical

Fluxes

Flavor

After “Needs”, “Selection” is Key



Why Design Different: CIA Exam (Culinary Institute of America)

- 4 Rabbits
- 5 Skate
- 0.5 kg Scallops
- 2 Lobsters
- Bacon
- Tomatillos
- Bosc Pears
- Dried Cherries
- Red Beans
- 1 Pineapple

Conclusion: For New Products,

- **Decide What to Make**
- **“Selection” Often Key**
- **“Needs” Can Be Key**

Performance Chemicals Are Often Microstructures

Solvents

Cleaners

Flavors, Aromas

Cosmetics

Ion X

Paints

Dyes

Pigments

Vitamins

Inks

Batteries

Polishes

Adhesives

Deicers

Lube additives

Membranes