

undergraduate faculty campus student college academic curriculum freshman classroom professor	<b>1</b>
moral considerateness bison whale governance utilitarianism ethic entity preference utilitarian	<b>2</b>
diabetes elderly appendix geriatric directory hospice arthritis parent dental rehabilitation	<b>3</b>
peel teaspoon tablespoon fry finely salt pepper cumin freshly ginger	<b>4</b>

undergraduate faculty campus student college academic curriculum freshman classroom professor	<b>1</b>	Madhur Jaffrey's Cookbook
moral considerateness bison whale governance utilitarianism ethic entity preference utilitarian	<b>2</b>	When Your Parents Grow Old
diabetes elderly appendix geriatric directory hospice arthritis parent dental rehabilitation	<b>3</b>	College: the Undergraduate Experience
peel teaspoon tablespoon fry finely salt pepper cumin freshly ginger	<b>4</b>	Earth and other Ethics

undergraduate faculty campus student college academic curriculum freshman classroom professor	<b>1</b>	College: the Undergraduate Experience
moral considerateness bison whale governance utilitarianism ethic entity preference utilitarian	<b>2</b>	Earth and other Ethics
diabetes elderly appendix geriatric directory hospice arthritis parent dental rehabilitation	<b>3</b>	When Your Parents Grow Old
peel teaspoon tablespoon fry finely salt pepper cumin freshly ginger	<b>4</b>	Madhur Jaffrey's Cookbook

# ***Mapquest.com directions from the Quad to Valley Forge***

- 1. Start out going East on SPRUCE ST toward S 36TH ST.**
- 2. SPRUCE ST becomes SOUTH ST.**
- 3. Merge onto I-76 W via the ramp on the left.**
- 4. Merge onto W DEKALB PIKE / US-202 S via exit number 328 toward US-422 W / SWEDESFORD RD.**
- 5. Merge onto COUNTY LINE EXWY / US-422 W toward POTTSTOWN.**
- 6. Merge onto W VALLEY FORGE RD / PA-23 W toward VALLEY FORGE.**
- 7. Turn RIGHT onto N GULPH RD / PA-23 / PA-363.**
- 8. Turn LEFT onto DAVIS RD.**
- 9. Turn RIGHT onto OAKWOOD LN.**

<b>merge</b>						
<b>turn left</b>	<b>onto</b>	<b>X</b>	<b>via</b>	<b>Y</b>	<b>towards</b>	<b>Z</b>
<b>turn right</b>						

# The same directions -- from Google Maps:

1. Head **west** from **Spruce St** - go **0.1** mi
2. Turn **left** at **S 38th St** - go **0.1** mi
3. Continue on **S University Ave** - go **0.3** mi
4. Bear **right** into the **I-76 W** entry ramp - go **18** mi
5. Take the **US-202 N/US-202 S/US-422 W** exit **328B-A** to **West Chester/King of Prussia/Pottstown** - go **0.7** mi
6. Bear **right** at **W DeKalb Pike** - go **0.0** mi
7. Bear **left** - go **0.1** mi
8. Continue on **N Gulph Rd** - go **2.5** mi
9. Bear **left** at **PA-23** - go **0.0** mi
10. Continue on **Port Kennedy Rd** - go **2.1** mi
11. Bear **right** at **Valley Forge Rd** - go **0.5** mi
12. Turn **left** at **Davis Rd** - go **0.1** mi
13. Turn **right** at **Oakwood Ln** - go **0.0** mi

Turn	right	at	X	-	go	Y.Z	mi
Bear	left	into					
Continue		on					

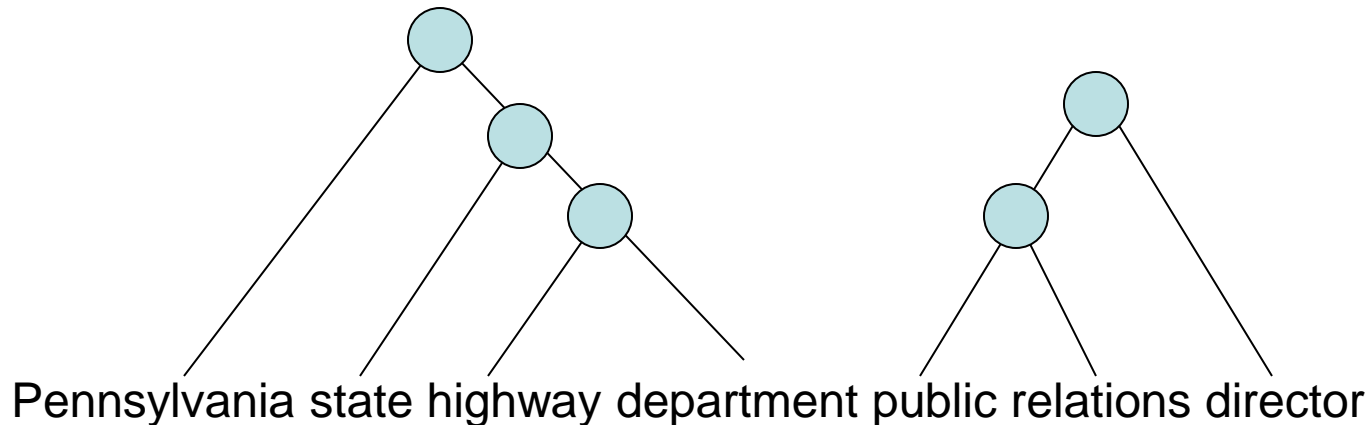
# Compositionality

Pennsylvania state highway department public relations director

Pennsylvania state (highway department) (public relations) director

Pennsylvania (state (highway department)) ((public relations) director)

(Pennsylvania (state (highway department))) ((public relations) director)



Penn A-Z



# Recursion

$$1 + 2 \times 3$$

$$(1 + 2) \times 3$$

$$1 + (2 \times 3)$$

$$\begin{aligned} & ((23 \times 5) + 2) / (3 + (9 \times 4)) \\ & (115 + 2) / (3 + 36) \\ & 117 / 39 \\ & 3 \end{aligned}$$

# Biomedical information extraction

*Amiodarone weakly inhibited CYP2C9, CYP2D6, and CYP3A4-mediated activities with  $K_i$  values of 45.1--271.6  $\mu\text{M}$*

<b>INHIBITOR</b>	<b>INHIBITEE</b>	<b>RATE</b>
amiodarone	CYP2C9	<b><math>K_i=45.1--271.6</math></b>
amiodarone	CYP2D6	<b><math>K_i=45.1--271.6</math></b>
amiodarone	CYP3A4	<b><math>K_i=45.1--271.6</math></b>

# Challenge: Diversity in Expression

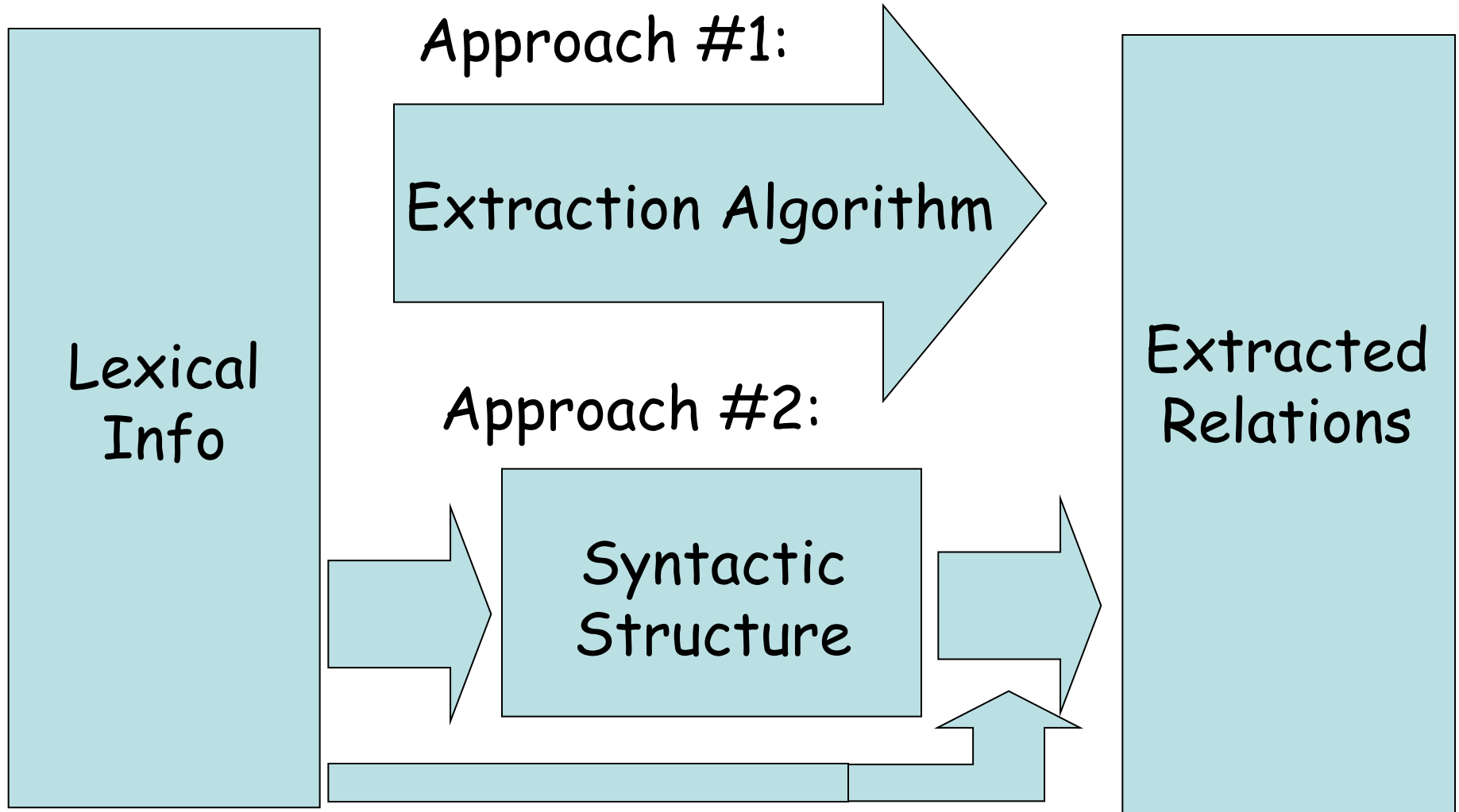
1. “Point mutations in codons 12 and 13 activated C-Ki-ras”
2. “Point mutations in codons 12 and 13 were activators of C-Ki-ras gene”
3. “Activation of the C-Ki-ras genes by point mutations in codons 12 or 13...”

Want to populate a factbank with:

activation(C-Ki-ras, point mutation in codon 12)

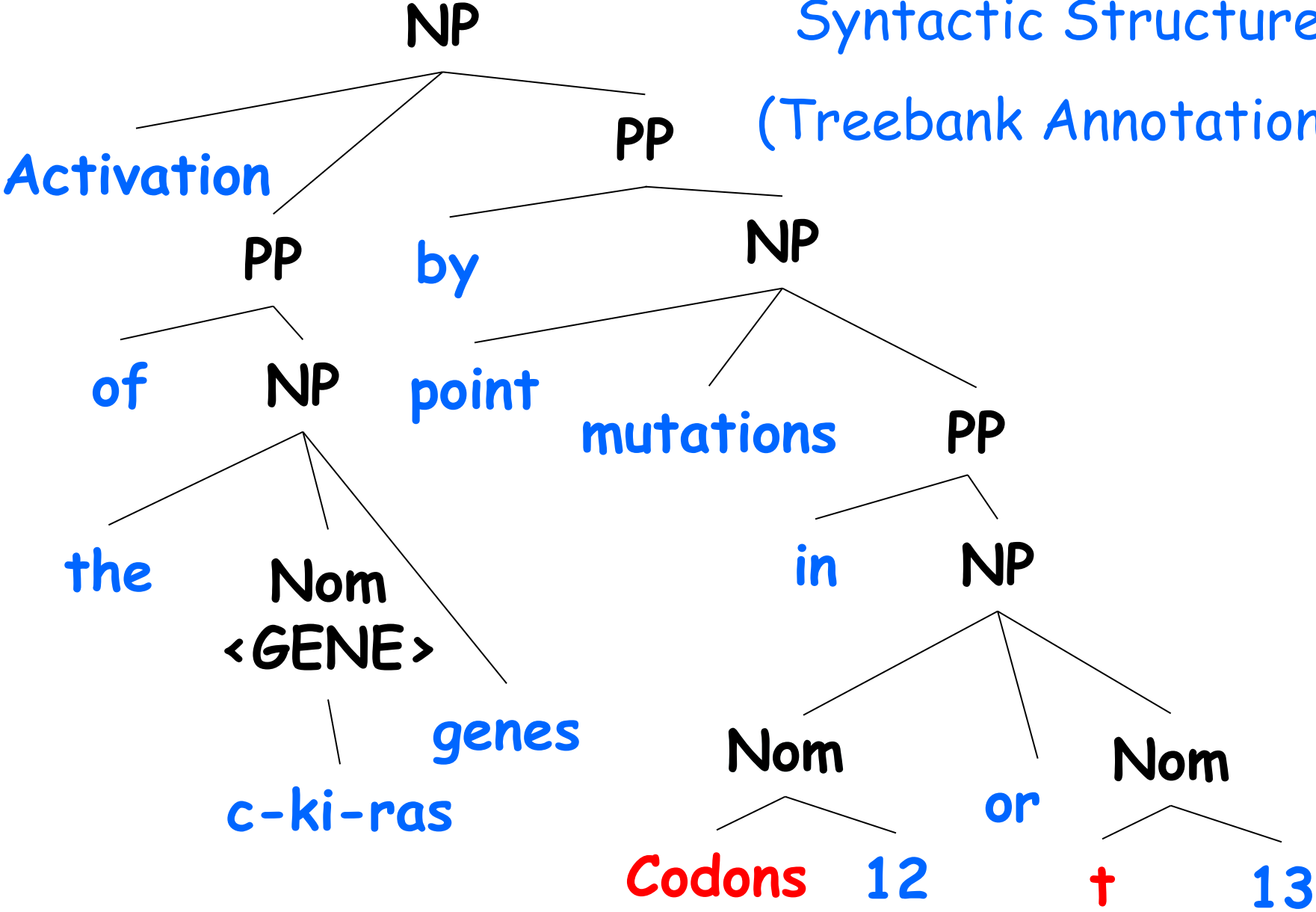
activation(C-Ki-ras, point mutation in codon 13)

# Information Extraction Approaches



# Syntactic Structure

(Treebank Annotation)



Biochemistry 1977 Jul 12;16(14):3177-81

**Cytochalasin inhibits the increase in conversion of [3H]cholesterol to 20alpha-[3H]dihydroprogesterone . . .**

FORM: A inhibits B

**Cytochalasin does not inhibit the conversion of pregnenolone to 20alpha-dihydroprogesterone but was shown to inhibit increased transport of [3H]cholesterol to mitochondria resulting from the action of ACTH**

FORM: A was shown to inhibit B



J Pharmacol Exp Ther 1990 Jul;254(1):129-35

The novel **H<sup>+</sup>/K<sup>(+)</sup>-adenosine triphosphatase inhibitor** (**gastric proton pump inhibitor**), **BY 1023/SK&F 96022**, was found to be more potent than **omeprazole** in some rat models and slightly less potent in a dog model

FORM: the **B inhibitor A**

Thus, the naturally occurring non-aromatizable 5alpha-reduced androgen metabolites, **5alpha-dihydrotestosterone** and **5alpha-androstanedione**, **proved to be potent competitive inhibitors** of **the granulosa cell aromatase reaction** in vitro.

FORM: **A1** and **A2** proved to **be inhibitors of B**

In this respect each of these biologically active androgens was more effective than **1-enetestololactone**, an established **C19 steroidal aromatase inhibitor**

FORM: **A**, a **B inhibitor**

Biochem Pharmacol 1993 Nov 2;46(9):1529-38

**Covalent binding to protein was also inhibited by gestodene**

FORM: **B was inhibited by A**

Biochem Pharmacol 1996 Jul 12;52(1):73-84

**Efficient inhibition of testosterone 2 alpha- and 16 alpha-hydroxylation by complex formation with orphenadrine in microsomes of untreated male rats**

FORM: **inhibition of B by A**

## Forms seen so far:

A inhibits B
the B inhibitor A
A1 and A2 proved to be inhibitors of B
A, a B inhibitor
B was inhibited by A
inhibition of B by A

Others expected? e.g. inhibitory effect of A on B . . .

Nature of these constructions?

IL-12 is able to inhibit allergen-induced airway changes

Cyclosporine has been reported to inhibit ODC activity

their ability to inhibit chemotaxis

diisopropyl fluorophosphate was unable to inhibit actin polymerization

TgCDPK1 was found to be inhibited effectively by KT5926

the growth inhibitory effect of TGF beta 2 on mink lung carcinoma

Beromycin had a selective inhibitory effect on synthesis of nucleic acids

the inhibiting effect of **epithalamin** on **lipid peroxidation processes**

only **cyclophosphamide** was capable of inhibiting **EAU**

Besides inhibiting **isoprostane production**, **21-aminosteroid** reduced hydrogen ...

**Human plasma cholinesterase** was shown to be inhibited by **propanidid**

the inhibition of **the nocturnal surge of prolactin** by **estrogen**

**NO** is inhibiting **the conversion of cholesterol to pregnenolone**

## Morphology and syntax...

inhibit
inhibits
inhibited
inhibition
inhibiting
inhibitory

# Coordination

Inhibition of **CB-52** and -101 **metabolism**

Inhibition of

**CB-52** **metabolism** and **CB-101** **metabolism**



Now here is a sentence from a popular and excellent German novel -- which has a slight parenthesis in it. I will make a perfectly literal translation, and throw in the parenthesis-marks and some hyphens for the assistance of the reader -- though in the original there are no parenthesis-marks or hyphens, and the reader is left to flounder through to the remote verb the best way he can:

"But when he, upon the street, the (in-satin-and-silk-covered-now-very-unconstrained-after-the-newest-fashioned-dressed) government counselor's wife **met**," etc., etc.

That is from *The Old Mamselle's Secret*, by Mrs. Marlitt. And that sentence is constructed upon the most approved German model. You observe how far that verb is from the reader's base of operations; well, in a German newspaper they put their verb away over on the next page; and I have heard that sometimes after stringing along the exciting preliminaries and parentheses for a column or two, they get in a hurry and have to go to press without getting to the verb at all. Of course, then, the reader is left in a very exhausted and ignorant state.

Mark Twain, "[The Awful German Language](#)" (1880)

Wenn er aber auf der Strasse  
der in Sammt und Seide gehüllten jetzt sehr ungenirt  
nach der neusten Mode gekleideten Regierungsräthin  
begegnet.

But when he, upon the street,  
the (in-satin-and-silk-covered-now-very-unconstrained-  
after-the-newest-fashioned-dressed) government counselor's wife  
**met,**

"He used to have this great, dignified passion to him," Christopher Hitchens, who, until his own political change of heart, defended Chomsky, **says**.

(Larissa MacFarquhar. The devil's accountant. *The New Yorker*, March 31, 2003 (p. 67, column 2).)

"I would hope that, based on the President's judicial nominations so far, you will see him appoint Justices more in line with a conservative judicial philosophy," Jay Sekulow, the chief counsel to the American Center for Law and Justice, an advocacy group funded by the Reverend Pat Robertson, **says**.

(Jeffrey Toobin. Advice and dissent. *The New Yorker*, May 26, 2003 (p. 48, column 1))

"Every fair-minded person knows that when Iraqi officials say something, they are trustworthy," said Saddam Hussein, President for Life and Conscience of the Culture of Iraq, not to mention of the Internal Security Forces of Iraq, recognizing his responsibility as an artist (he is the author of two romantic novels, *Zabibah and the King* and *The Fortified Castle*, both acclaimed by leading Iraqi critics) to tell the truth, in his own way.

(Michael Kelly. What now? *The Atlantic*, April 2003.

luck light than feather  
not it know carry  
misfortune heavy than earth  
not it know avoid

but not ever I criticize