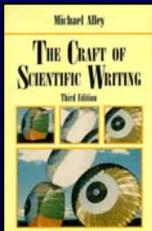


# Language in Scientific Writing

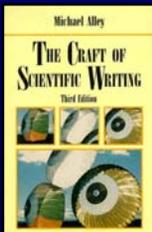
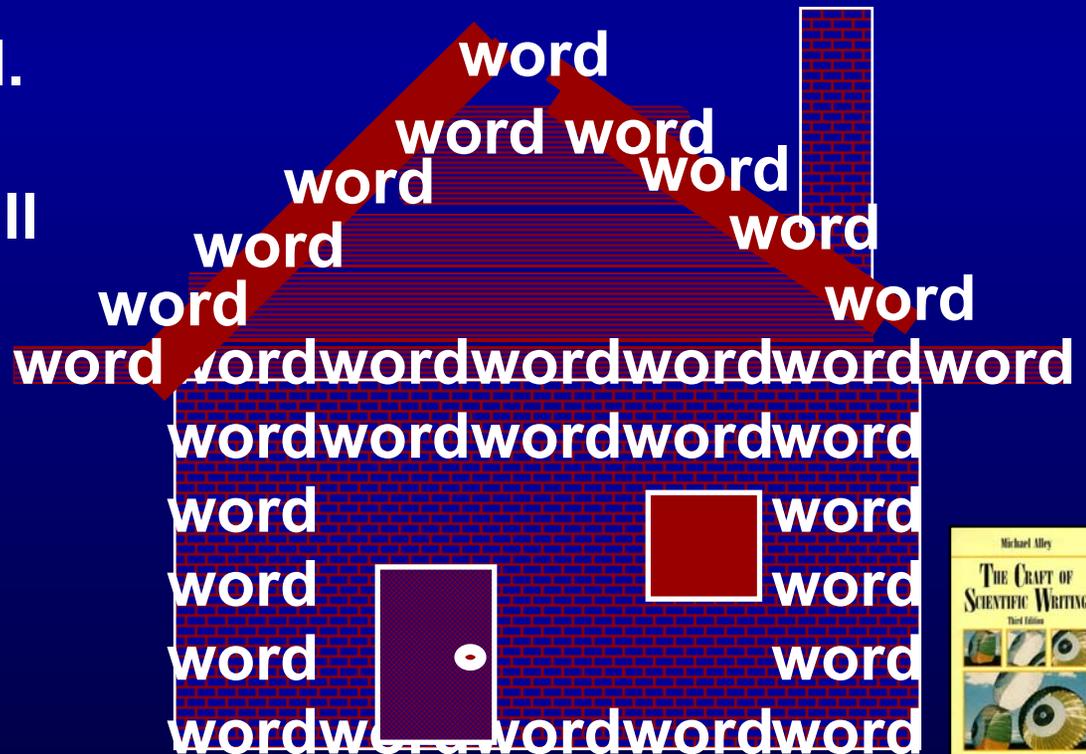
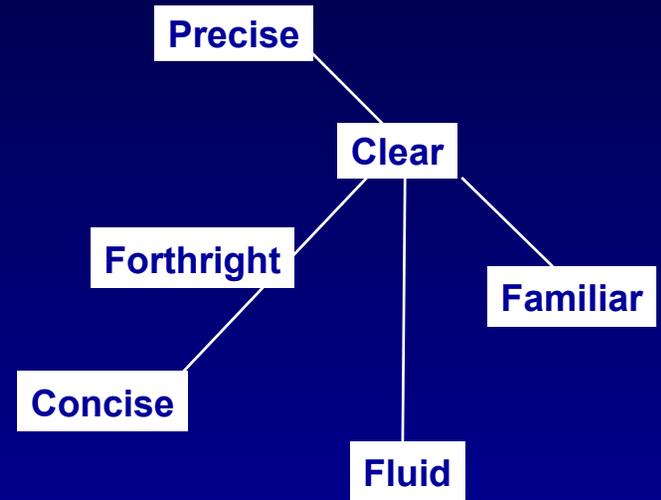
These slides, which are used in graduate and undergraduate engineering courses at Virginia Tech, come from Chapters 4 through 9 in *The Craft of Scientific Writing* (3rd ed., Springer-Verlag).



# Language: the Way We Use Words

Short words are the best, and short words when old are best of all.

Winston Churchill

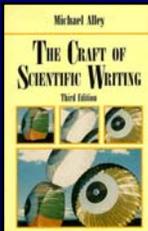


# Generalities that are not anchored with specifics are soon forgotten

After recognizing some problems with the solar mirrors, we took subsequent corrective measures.

After finding that high winds (and not hail) had cracked the ten solar mirrors, we began stowing all mirrors in a horizontal position during thunderstorms.

Trash

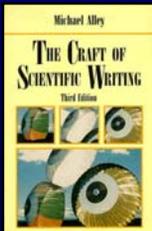


## For precise language, you should avoid over-specifying details

The number of particular hydrocarbon combinations in our study is enormous. For example, the number of possible  $C_{20}H_{42}$  is 366,319 and the number for  $C_{40}H_{82}$  is 62,491,178,805,831.



The number of hydrocarbon combinations in our study is enormous. For example, the number of possible  $C_{40}H_{82}$  is more than 62 trillion.

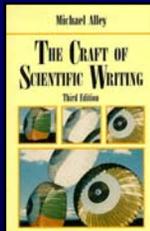


# For precision, you must choose the appropriate level of detail

Operations at the plant stopped momentarily because the thermal storage charging system desuperheater attemperator valve was replaced.



Operations at the plant stopped for 1.5 hours so that a valve in the thermal storage system could be replaced.



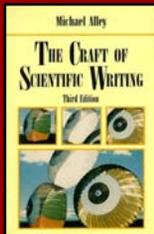
# Complex wording also buries ideas

This study will consider why current solar energy systems, such as Solar One, have not reached the commercial stage and will find out what steps we can take to make these systems commercial.



**R.I.P.**

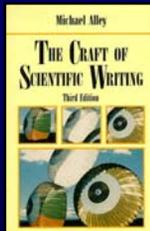
The goal of this study is to develop a commercialization strategy for solar energy systems by analyzing factors impeding early commercial projects (i.e., SOLAR ONE) and by identifying the potential actions that can facilitate the viability of the projects.



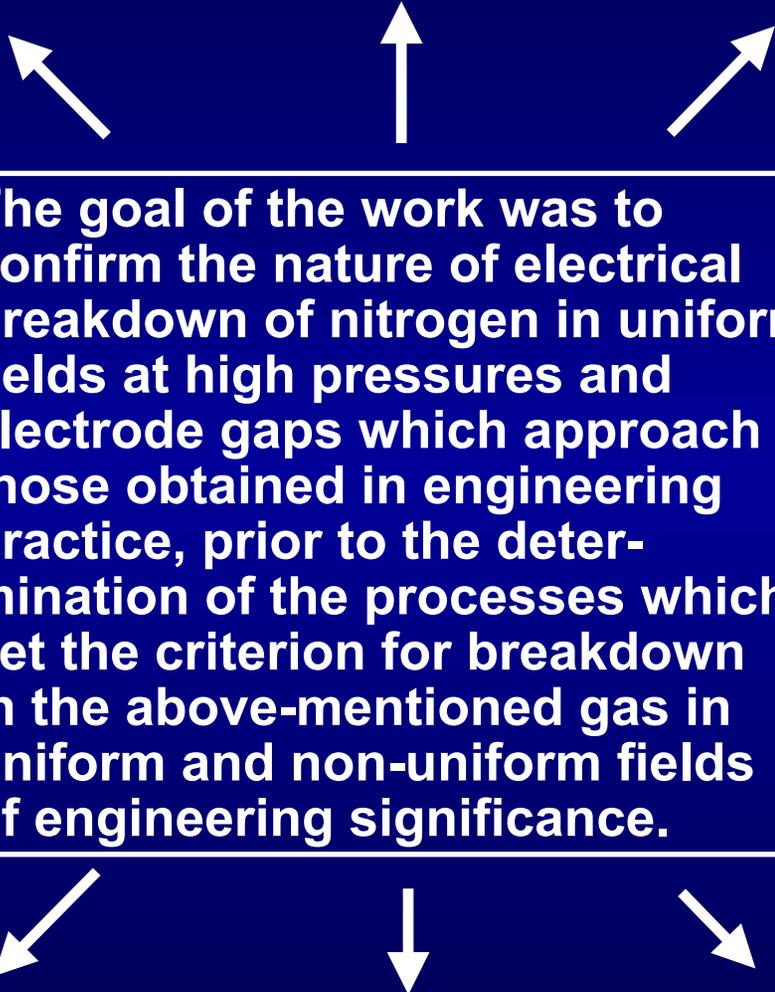
# Stacking adjectives before nouns swallows the ideas

Solar One is a 10 megawatt solar thermal electric central receiver Barstow power pilot plant.

→ Solar One is a solar-powered pilot plant located near Barstow, California. Solar One produces 10 megawatts of electricity by capturing solar energy in a central receiver design.

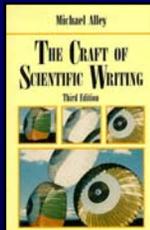


# Complex sentences misdirect readers



The goal of the work was to confirm the nature of electrical breakdown of nitrogen in uniform fields at high pressures and electrode gaps which approach those obtained in engineering practice, prior to the determination of the processes which set the criterion for breakdown in the above-mentioned gas in uniform and non-uniform fields of engineering significance.

At high pressures (700 torr) and typical electrode gap distances (1 mm), the electrical breakdown of nitrogen was studied in uniform fields.

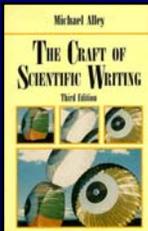


# The more muddled the original, the more revisions are needed to streamline it

At high pressures (760 torr) and typical electrode gap distances (1 mm), the electrical breakdown of nitrogen was studied in uniform fields.



In our study, we examined the electrical breakdown of nitrogen in uniform fields. For these experiments, the electrode gap distances were typical (1 mm), while the pressures were relatively high (760 torr).



# One measure for the complexity of the writing is the Gunning Fog Index

In the index, the complexity of the writing depends on  
(1) the lengths of sentences  
(2) the lengths of words

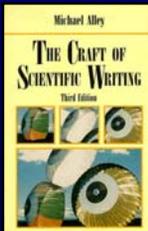
Desired index values for scientific writing are 10-12:  
*New York Times* (11)  
*Scientific American* (12)

$$F_i = 0.4 \left( (N_w / N_s) + P_{lw} \right)$$

$N_w$  = number of words in a *typical* paragraph

$N_s$  = number of sentences in the paragraph

$P_{lw}$  = percentage of long words in the paragraph



**An ambiguity is a group of words that can have more than one meaning**

**We examined neat methanol and ethanol and methanol and ethanol with 10% water.**



**We examined four fuels: neat methanol, neat ethanol, methanol with 10% water, and ethanol with 10% water.**



# Ambiguities occur for many reasons

The proposed schedule is discussed below for the next four years.

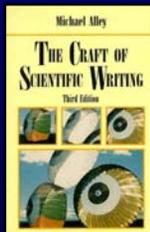
??????????

As light hydrocarbons evaporate the oil vapor pressure falls.

??????????

Although engineers realized the design flaws in the Titanic soon after its sinking in 1912, the reasons for the severe damage inflicted by the iceberg remained a mystery until its discovery in 1985.

?????



# Pretentious diction often causes problems with tone

approximately

facilitate

implement

individualized

operationability

utilization

about

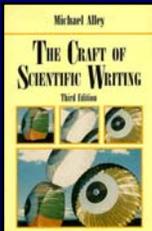
cause; bring about

carry out

individual

can operate

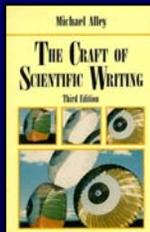
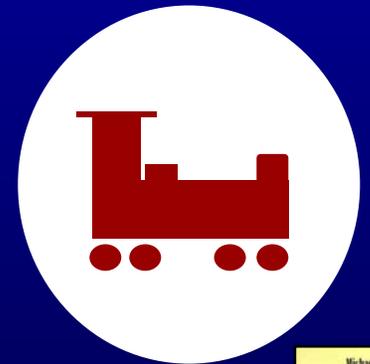
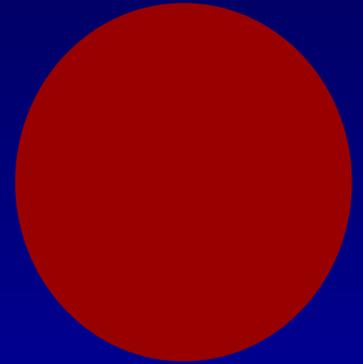
use



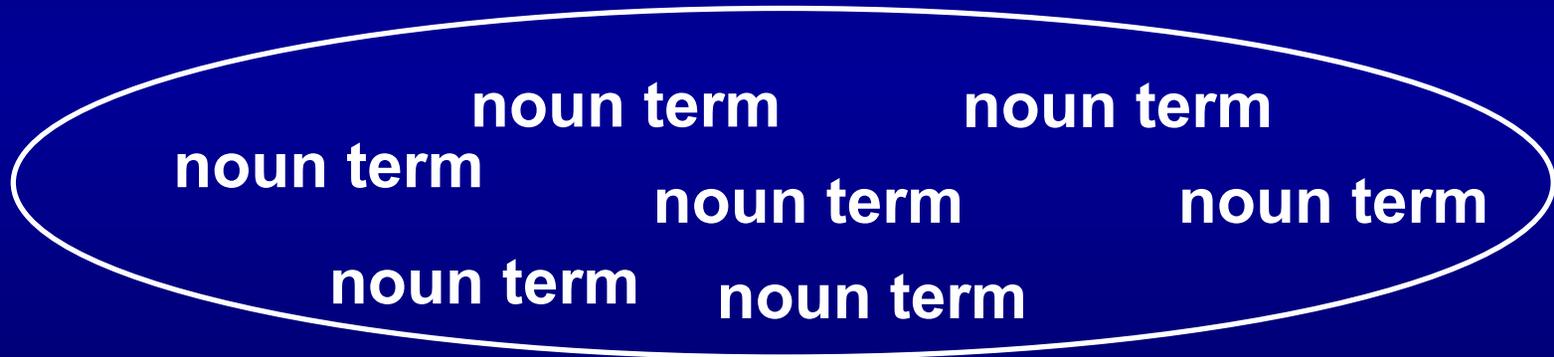
# Weak verbs hide the energy of your work

A new process for eliminating nitrogen oxides from diesel exhaust engines is presented. Flow tube experiments to test this process are discussed. The percentage decrease in nitrogen oxide emissions is revealed.

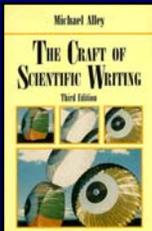
This paper presents a new process for eliminating nitrogen oxides from the exhaust of diesel engines. To test this process, we performed experiments in flow tubes. These experiments revealed a 99 percent decrease in nitrogen oxide emissions.



# A formal definition has a specific form



**Bremsstrahlung: the radiation emitted by a charged particle that is accelerated in the Coulomb force field of a nucleus.**

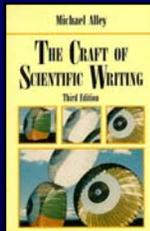


# To tighten your writing, eliminate redundancies and writing zeroes

Vibration measurements made in the course of the Titan flight test program were complicated by the presence of intense high-frequency excitation of the vehicle shell structure during the re-entry phase of the flight.



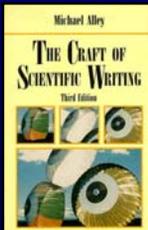
Vibration measurements made in the Titan flight were complicated by intense high-frequency excitation of the vehicle shell during re-entry.



## Examples anchor abstract generalities

By the late Middle Ages, cities throughout Europe were building Gothic cathedrals. The only way, however, that architects could test a new design was to build the cathedral, a process that took more than forty years. Unfortunately, many cathedrals caved in during or after construction. What took forty years to test in the Middle Ages could have been done in minutes on a supercomputer.

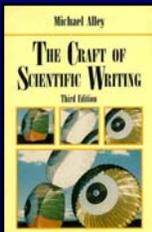
William Wilson



# When sentence openers do not vary, the sentences do not seem to connect

Z  
Z  
Z

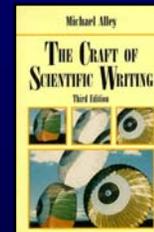
Mount St. Helens erupted on May 18, 1980. A cloud of hot rock and gas surged northward from its collapsing slope. The cloud devastated more than 500 square kilometers of forests and lakes. The effects of Mount St. Helens were well documented with geophysical instruments. The origin of the eruption is not well understood. Volcanic explosions are driven by a rapid expansion of steam. Some scientists believe the steam comes from groundwater heated by the magma. Other scientists believe the steam comes from water originally dissolved in the magma. We need to understand the source of steam in volcanic eruptions. We need to determine how much water the magma contains.



# Varying sentence openers allows for more kinds of transitions between sentences



Topic of Sentence	←	Subject
Time of action	←	Prepositional Phrase
Location of action	←	Prepositional Phrase
Manner of action	←	Adverb
Subordinate action	←	Dependent Clause
Reason for action	←	Infinitive Phrase



# Vary sentence openers to vary rhythm

● subject-verb

Mount St. Helens erupted on May...

● prepositional phrase

In minutes, the mountain emitted...

● adverb

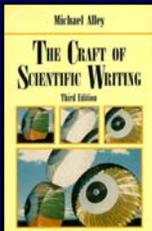
Recently, debate has arisen...

● dependent clause

Although the exact time of the eruption surprised scientists, evidence had been collected...

● infinitive phrase

To understand the eruption, we have to...



# Varying sentence openers enlivens the writing and allows connections

Mount St. Helens erupted on May 18, 1980. Its slope collapsing, the mountain emitted a cloud of hot rock and gas. In minutes, the cloud devastated more than 500 square kilometers of forests and lakes. Although the effects of the eruption were well documented, the origin is not well understood. Volcanic explosions are driven by a rapid expansion of steam. Recently, debate has arisen over the source for the steam. Is it groundwater heated by magma or water originally dissolved in the magma itself? To understand the source of steam in volcanic eruptions, we need to determine how much water the magma contains.

