NATURAL SCIENCES 3 THE PHYSICAL BASES OF EXPLANATION
SHIMER COLLEGE WEEKEND PROGRAM FALL 2008

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INTRODUCTION

What things need to be explained? How are they explained? What does explanation mean? What does it reveal about the nature of reality?

These and similar questions are the concern of Natural Sciences 3. As you can see, they are very general questions, not particularly having to do with physics or any other natural science. Why, then, do we claim this as a natural science course? Because we treat these questions in the context of physical science. This is necessary for a reason you may find surprising: the questions are easiest to work with within the context of the natural sciences. The nature of explanation in almost any other field is much more elusive and unwieldy. Try to explain a person's behavior, or that of a nation, or an artistic experience. It is much easier to explain the phenomenon of a falling stone.

And this is precisely where we start, that is with Galileo's explanation of falling bodies. You might at first wonder what profound discoveries can possibly come out of watching such commonplace occurrences as falling bodies, but in the first selection the commonplace becomes deeply fascinating. He seems to have discovered an important law of nature without any observation at all, just by reasoning. Do you believe it?

From the explanation of falling we go to the explanation of motion in general, motion of people, cars, planets. When the explanation of motion is established, we try to apply it to a motion that baffled and still baffles the best minds: the movement of light. The fundamental question of NS3 becomes: **What is light?** The historical wave / particle controversy about light is settled in favor of waves, but only temporarily. A wave has to be a wave in some medium; this medium for light waves was called the aether. The way to fathom the nature of this aether is through the study of electrical and magnetic forces. But no sooner is the existence of the aether established then it leads to grave problems, both logically and observationally. When the theory of relativity resolves these problems, what is left of the aether is a new entity called the field. Now, this is not merely a new name for aether; it is a new reality -- as real as stones and trees. But the field is not fathomed by any of our senses, even when assisted by instruments, but only through the intellectual tool known as mathematics.

ASSIGNMENTS

One important paper - and class participation - will constitute your graded assignments for NS3. The paper is an account of your experience and experiments with the prism supplied to you as part of the course materials. Carry your prism around with you; observe the world through it; take notes. Also, bring it to class on a regular basis. Your paper should be both a record of your observations and a theoretical explanation of them. It should be handed in at the beginning of weekend #5. Late papers will be discounted one full grade level for each week they are late. The paper should be eight to twelve typed pages and will contribute 40% to your grade; class participation will constitute the other 60%. Your class grade will be divided between your individual effort and the corporate effort of the class, as determined by the class as a whole.

CLASS ATTENDANCE POLICY

Four unexcused absences are sufficient grounds for the instructor to drop a student from the course. The instructor will warn the student after two such absences. Once dropped from the course, the student may be reinstated by the instructor only under a rigorous contractual agreement.

PHILOSOPHY OF LEARNING

It is expected that NS3 will mark a shift away from a self-protective and conformist learning attitude toward a responsible and autonomous position in which dialogue and community become most important. At the “3" and “4" level courses there is an expectation that students in a class will realize their corporate responsibility for class discussion and will move away from the “normal” student position of being both rewarded and punished by the faculty member in his/her role as sole judge. In adopting and practicing this policy, we all need to be conscious of the difficulty/fear we have in making and expressing judgments.

READINGS

WEEKEND #1
Galileo, DIALOGUES CONCERNING THE TWO NEW SCIENCES
FIRST DAY, paragraph prior to section #106 through section # 131
THIRD DAY, section #190 through section #213

WEEKEND #2
Continuation of the discussion of THIRD DAY
Newton, PHILOSOPHY OF NATURE
THE METHOD OF NATURAL PHILOSOPHY, pp. 3-8
PREFACE, pp.9-11
DEFINITIONS & SCHOLIUM, pp. 12-25
LAWS OF MOTION, pp. 25-40
ON GRAVITY, pp. 105-134

WEEKEND #3
Newton, OPTICS
Book One
Definitions, pp. 1-4
Axioms, pp. 5-10, 18-20
Propositions, pp. 20-44, 75-82, 165-168
Book Two, pp. 193-203, 214-221
Book Three, pp. 317-330, 339-353, 362-374
Newton, ETHER AND GRAVITY (pp.112 – 116 in Selected Readings)
Descartes, OPTICS (pp.152 – 164 in Selected Readings)

WEEKEND #4
Huygens, TREATISE ON LIGHT (in Selected Readings)
Young, THE INTERFERENCE OF LIGHT (in Great Experiments in Physics)
Young, ON WAVES (in Selected Readings)
Fresnel, THE DIFFRACTION OF LIGHT (in Great Experiments in Physics)

WEEKEND #5
DuFay & Franklin, TWO-FLUID . . . THEORIES OF ELECTRICITY (in SR)
Oersted, ELECTROMAGNETISM (in Great Experiments in Physics)
Faraday, SELECTIONS (in Selected Readings)
Paper on Light due this weekend !!

WEEKEND #6
Hertz, ELECTROMAGNETIC WAVES (in Great Experiments in Physics)
Hertz, SELECTIONS (in Selected Readings)
Maxwell, ON ACTION AT A DISTANCE & ETHER (in Selected Readings)

WEEKEND #7
Einstein, RELATIVITY (General Theory // you may want to review the Special Theory as well)