Carl –
I thought the enclosed
material might interest you.
Dave

UNIVERSITY OF HAWAII
Institute for Astronomy

MEMORANDUM

September 3, 1970

TO: John Holmes, Jack Zirker, Astronomy Teaching Faculty

FROM: David Morrison DM.

SUBJECT: Physics 111

In the summer session just ending I taught Physics 111, Special Topics in Astronomy, to a class of 18, most of whom were non-science sophomores and juniors. This was my first experience with college teaching, so I do not expect that the insights that I may have gained will be new to you who have much more teaching experience. Still, I hope that this memo and the enclosed material will be of some interest.

I am very impressed by the opportunity that an elementary astronomy course offers to teach some understanding of physical science and of the methods of science to a non-science undergraduate. I believe that astronomy is better suited to this function than any elementary physics presentations I know of. By its descriptive nature, its broad and "mind-stretching" subject matter, and its long history of interaction with the humanistic traditions of our society, it seems ideally suited to interest and instruct the non-science student. When I read of other universities, comparable in size to the University of Hawaii, at which more than a thousand students are enrolled annually in elementary astronomy courses, I cannot help feeling that we are missing an opportunity here. I hope that Physics 110 and 111 will continue their recent record of growth until we reach enrollments of similar size.

The relative merits of 110, a survey course, and 111, a special topics course, are not easy to judge. I do think that the special topics approach can be an exciting way to teach astronomy, both for the instructor and for the students, and I hope that others of the teaching faculty will be interested in experimenting with this course. Enclosed is a summary of my own choice of topics. If I were doing this course again, I would substitute a study of stellar evolution for the material on distance measurement in the universe, and I would omit bothering with such details as the astronomical magnitude system. The topics that we touched upon that were of most interest to my students were cosmology, space exploration, Mars, and intelligent life in the universe. Incidentally, I think that Shklovskii and Sagan is an excellent text for an elementary astronomy course. If I had had time, I would have liked to teach a topic in pseudo-science, such as a discussion of UFO's or of Velikovsky's Worlds in Collision. I suspect that the students could learn a great deal about science from a careful

critique of such popular scientific fallacies as these.

My most difficult problem was conveying to the students an understanding of the criteria by which scientific "truth" is judged. Indeed, near the end of the course, some of them still seemed to think that an unsupported opinion, or an observationally untestable one, was consistent with science. For instance, two students suggested that a good exam question might be to ask them to "state your own theory for the origin of the universe," and one thought that he would like to see a question asking the student to discuss the liklihood that electrons were miniature inhabited worlds. On the other hand, I do think that I was successful in making most of the students aware of the way our knowledge grows and changes as new information comes to light. Thus, they accepted the differences between the "facts" as stated in their text books and as related by me in lecture, and they seemed to grasp, for example, the way in which specific experiments on the Mariner spacecraft were designed to test theories, and the way such tests interacted with theoretical models for the atmosphere and surface of the planet. I was also pleased that no one criticized science, or even the unmanned space program, as irrelevant or a waste of our talent and resources. Indeed, they acted as if they looked forward to sharing in the excitement of such adventures as the Viking landings on Mars.

Availability of more visual aids would have made teaching this course easier. The departmental slide collection is inadequate. And I would like to see us purchase several good films on astronomy, such as the two produced by the AAS: "A Radio View of the Universe" and "Exploring the Milky Way." A thousand dollars for the purchase of visual aids would be a good investment, it seems to me, especially in view of the growing enrollment in elementary astronomy courses.

I took my class once to visit the Bishop Planetarium, and I feel that this trip was worthwhile. In contrast, my attempts to use the department's telescope on HIG were a total waste of time. The mounting was unabalanced, and the drive did not work. But the main problem is the really terrible atmospheric seeing from anywhere in Honolulu, but especially from the top of that hot, flat roof. How can you teach anything about observation in astronomy with a telescope in which you cannot see the bands on Jupiter, or even tell that Venus (at half phase) is not fully illuminated? I see little educational value in this telescope; better to forget such attempts to make astronomy a lab subject and rather to depend on good lectures, supplemented by effective use of slides and films, to get the message across.

Enclosed with this memo are copies of the class assignments and of the exams that I gave this summer. If any of you would like further information, please ask me. Also, I have course evaluation sheets in which the students gave detailed criticism of texts, exams, etc.

DM/mm
Enclosures

PHYSICS 111

DATES	TOPIC	READING
July 29-31	Introduction	Shklovskii & Sagan, pp. 1 - 143
August 3-7	Distances & Structure	Shatzman, pp. 1 - 168
August 10	Cosmology	" pp. 169 - 246
August 12-14	Solar System	Shklovskii & Sagan, pp. 144 - 181
August 17-18	Venus	Ohring, pp. 1 - 106
August 19-21	Mars	Shklovskii & Sagan, pp. 182 - 325
August 24-27	Mars	Glasstone, pp. 1 - 152
Aug. 31-Sept. 2	Intelligent Life	Shklovskii & Sagan, pp. 326 - 488
Sept. 3	Review	

Texts: Shklovskii and Sagan: Intelligent Life in the Universe

Shatzman: The Structure of the Universe

Glasstone: The Book of Mars

Ohring: Weather on the Planets

Other reading: Shapley, from the Shapley-Curtis debate

V. R. Eshleman: The Atmospheres of Venus and Mars (Scientific Amer.)

R. Leighton: The Surface of Mars (Scientific American)

Morrison: Intelligent Life in the Universe and Interstellar Communication (manuscript)

PHYSICS 111 Hour Exam NAME:

11 August 1970

1) Identify the following in one or two sentences. (15 pts)

1. Doppler Effect

2. Cepheid Variable

3. Large Magellanic Cloud

4. Absolute Magnitude

5. Parsec

6. Red Giant

7. Hubble Law

8. Quasar

9. Statistical Parallax

10. Astronomical Unit

2) Make a sketch, as was done in class, showing the electromagnetic spectrum from x-rays (on the left) to radio waves (on the right). Name the regions of the spectrum and give approximate wavelengths in cm. Indicate the "window" regions where the atmosphere of the Earth is transparent. (5 pts)

3) Suppose that you are on the planet Jupiter and that you measure the trigonometric parallax of a nearby star to be one arcsec. The length of a year on Jupiter is 12 Earth years and the radius of the orbit of Jupiter is 5 AU. What is the distance to this star? Draw a skinny triangle and show your work. (5 pts)

4) Consider the exploding star observed in 1885 in the Andromeda galaxy. The apparent magnitude at peak was m = +10. Astronomers at the time thought this star was like the novae in our galaxy, which have peak absolute magnitudes of about -9, so they concluded that the distance to the Andromeda galaxy was less than 10^5 pc. Later it was learned that this had been a supernova of absolute magnitude M = -15. With this information, calculate a new distance to this galaxy. Show your work. (5 pts.)

5) Describe the method of spectroscopic parallax as a means of finding the distance to a star. Include in your discussion a sketch of the spectral-luminosity (or H-R) diagram, showing the location of the main types of stars. (10 pts.)

PHYSICS 111 HOUR EXAM II NAME:

28 August 1970

1) Identify the following in one or two sentences. (36 pts)

1. Terrestrial Planet
2. Big Bang Theory
3. Troposphere
4. Limonite (Fe_2O_3)
5. Scale Height
6. Mariner
7. Continuous Creation
8. Martian Blue Haze
9. Chaotic Terrain

2) Write what you think would be a good essay question for the final exam in this course. (4 pts)

3) Describe the seasonal changes that are seen to take place on Mars. Compare these changes with those that would be seen on Earth if it were observed with comparable resolution. (20 pts)

4) Discuss the radio occultation method of investigating the atmosphere of a planet. Indicate how the experiment is performed and what can be learned about the atmosphere, giving specific examples from the study of Venus and Mars. (20 pts)

5) Name and briefly describe two major unsolved problems concerning the nature of Venus and two concerning the nature of Mars. (20 pts)

NAME_____

PHYSICS 111 FINAL EXAM
September 4, 1970

1) Identify any five of the following in one or two sentences. (20 pts)

1. Globular cluster
2. Quasar
3. Reducing atmosphere
4. Olber's paradox
5. Supernova
6. Main sequence

2. The apparent expansion of the universe, as described by the Hubble Law, is one of the fundamental observational facts that any cosmological theory must deal with. Describe the Hubble Law and outline the way in which it has been observationally determined. Include a discussion of the ways of measuring both velocity and distance of the galaxies. (20 pts)

3) Suppose that you are a hypothetical martian astronomer and have available, on Mars, a 200-inch optical telescope equipped with a spectrograph and radiometer with which to make visual and infrared observations of Earth What could you learn (and how) about the atmosphere and surface of the Earth? Could you detect life on Earth with this equipment? (20 pts)

4) Compare and contrast the atmospheres of Venus, Earth and Mars, discussing composition, pressure, temperature, structure and weather. (20 pts)

5) It has been suggested that the U.S. should, as a national goal, undertake a systematic search for radio signals from extraterrestrial civilizations. Discuss this suggestion, with attention to the following two questions: (20 pts)

a) Is it technically feasible to undertake such a project with a reasonable hope of success;

b) Would it be desirable to discover and communicate with extraterrestrial civilizations?