

letters

materials science to produce long-lived and selective high-temperature optical coatings. Furthermore, the destructive interlayer diffusion experienced by layers of coatings and the optical constants of such thin layers are still not well understood. In photovoltaic conversion, there must be a new method of growing silicon, because the Czochralski process is extremely wasteful and silicon ribbons are only 12% efficient. As for solar-sea power, a suitable working fluid and a highly efficient generator design must be found to accommodate the small temperature differential.

It must be kept in mind that we need another fuel for vehicles as well as other energy sources for electricity generation—this fuel will be hydrogen. Hydrogen can be obtained by electrolysis in power plants, or through a new, low-temperature chemical process using lithium nitrite and iodine. Moreover, hydrogen can be used to produce electricity in fuel cells, once the development of stable electro-catalysts and porous electrodes is complete.

Conclusion. In all the required research and studies discussed here, the physicist cannot act alone. He must work with the geologist and the climatologist to determine the effect on the climate of drawing geothermal energy with the marine-biologist to ascertain the effect of altering the ocean-thermal gradient on fish supply, with the chemist to find the best chemicals for the high-temperature fuel cells and above all, with the engineer in designing generators and engines. The crisis is worldwide in nature and affects the future of mankind itself; it therefore calls for a major international effort to work out the solutions. In this century there were two previous instances when the best scientific minds were used in cooperative efforts: at the Copenhagen Institute of Theoretical Physics in the early 1900's, and at Oak Ridge and Los Alamos during World War II. On both occasions, great work emerged.

The energy crisis is here, and the mechanism needed to coordinate work towards a solution—The International Energy Agency—is the place to begin. It is time for another meeting.

TAY YONG CHIANG
Raffles Institution
Singapore

Sears' last letter

The ancient scholar Lacydes (fl.c.241 BC), when asked late in life why he was studying geometry, replied

If I should not be learning now,
when should I be?
On his last day Francis Weston Sears, age 77, was writing me a letter explaining how he thought some of the more

difficult concepts of relativity theory could be taught. Mildred Sears, his wife, sent me the letter, adding that Sears had kept up academic correspondence with several people. The letter bore the same mark of clarity that characterized his textbooks and educational papers. I am honored to have exchanged knowledge with a wise man.

WILLIAM M. DECAMPLI
Harvard University

Quarks get prime time

CBS RADIO NETWORK NEWS-BREAK Thursday, January 1, 1976 8:30 AM EST

CHARLES OSGOOD: Newsbreak, Charles Osgood, reporting on the CBS Network.

There's a story on the front page of *The New York Times* this morning which contains the following sentence, quote: "The mating of a charmed quark with a charmed antiquark would not outwardly display charm because the antiquark would cancel the charm of the quark"—unquote. This is an absolutely serious story, mind you—the page one lead, followed up by much detail on page four.

We will explore the strange world of charmed quarks in just a moment.

Announcements

OSGOOD: *The New York Times* story about quarks this morning is under Walter Sullivan's byline, and it has to do with physics. It seems a quark is a subunit of matter . . . You cannot see a quark, even with the most sensitive microscope. However, physicists in this country and in Europe have come around to believing (many of them have, anyway) that quarks do indeed exist, and explains a lot of what goes on in the tiny little world of subatomic particles.

Well, now, according to the *Times* story, there is a very special kind of quark physicists are monkeying with, which displays a very elusive property which they call "charm." It is not charm in the sense of charm school or "Isn't so-and-so a charming person?" This is charm in the sense of living a charmed life. Somebody narrowly escapes disaster and you say about him, "Boy! he sure lives a charmed life . . ."

There are other parts to the quark theory. For one thing, for every particle of matter, they say there must be a particle that is exactly like it, but opposite, a mirror image, or antiparticle.

And that is how, today, in this *Times* story, there is this talk about anti-quarks and the mating of charmed quarks and so on. But never mind all that! We will leave it to the physicists. Let us only take the words and play with them:



Precision Translators



Stable rolling ball construction. Quality components. Smooth positioning. 15 models. Prices start at \$70.

Precision Optics



12 coatings. 40 substrate sizes and finishes. Stocked in OEM quantities for quick delivery.

Precision Lab Jacks



Innovative design virtually eliminates any side play or rocking. Two sizes.

Send for free catalog.

newport research corporation

18235 Mt. Baldy Circle
Fountain Valley, Ca. 92708
Phone (714) 962-7701
Telex 685535



Precision at affordable prices

Circle No. 11 on Reader Service Card