

literature, and preparation of slides, planning for accident prevention supervisory training, and recommendations for safety programs in the small plant.

Accident Frequency Down

Charts of accident frequency and severity in the fertilizer industry, based on data reported to the NSC by its members, show a gratifying downward trend in the past 15 years. The trend is clear and fairly consistent in the case of frequency; the severity curve seems also to trend downward, but with wider fluctuations, and smaller net improvement. The final frequency rate for 1955 has not yet been determined, of course; in mid-November it stood slightly higher than the 1954 figure, but the winter seasonal slump could bring it back into line.

While NSC has long served as a prime mover for greater fertilizer safety, it is by no means alone in its efforts. The National Plant Food Institute continues to give heavy emphasis to safety in its communications to its members and cooperates actively in the promotion of the NSC's programs. Regional and local safety groups, too, are active.

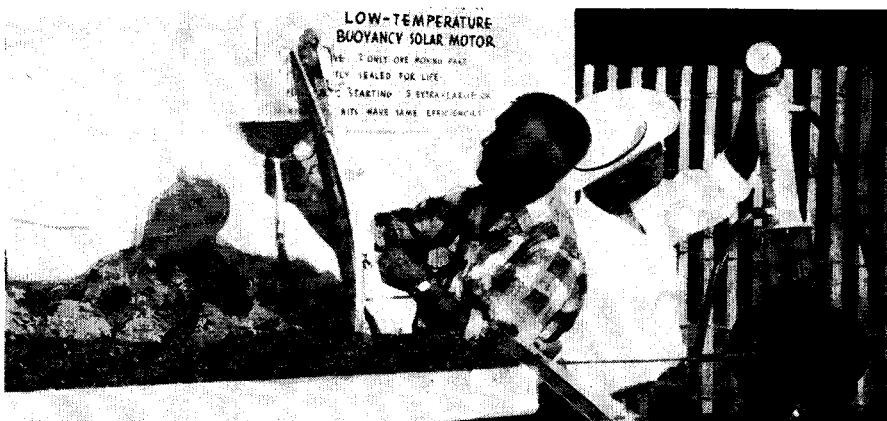
Individual companies vary greatly in the amount of time and effort they give to safety promotion, but the trend is generally in the direction of increasing the total effort while improving the efficiency of safety training and supervision. Here again the NSC plays an important role through distribution of safety information and training aids, sponsorship of nationwide safety contests, and provision of a forum for exchanging ideas.

With growing awareness of the human relations value of safety operation—and an appraising eye on the economic advantages it offers—fertilizer manufacturers are investing more of their time and money each year in safety programs.

Solar Energy

It isn't just around the corner, but research forges ahead on algae, engines, and weather

SOME 20 million kilocalories of solar radiation fall on each acre in the medium latitudes each day, but so far the world's technology hasn't tapped this most abundant energy source to any practical degree. However, the vast potential of solar energy isn't being overlooked; some 1000 scientists from 30-odd nations gathered in Arizona last month for a six-day session under joint sponsorship of Association for Applied Solar Energy, Stanford Research Institute, and University of Arizona.



Solar motor demonstrated by its developers for irrigating model of desert country

While progress reported and predictions for the future may not have taken any startlingly new turns, the conference did serve to bring authorities together and to focus attention on where we stand.

Much of the effort directed toward solar energy use is agriculturally oriented; algal cultures for food, fuel, or chemicals; solar stills to distill brackish water for irrigation; solar pumps for irrigation water; solar collectors and reflectors for controlling microclimates in agricultural areas.

Algae may not find a place on the table in surplus-surfeited United States for a bit, but University of California workers Harold B. Gotaas and William J. Oswald are forging ahead on a sewage treatment process that makes algae economically attractive in protein deficient tropical regions and of potential interest as a livestock feed even in the U. S. In the Gotaas-Oswald system, under investigation for about five years now, sewage oxidation ponds are inoculated with green algae. Bacteria oxidize the wastes, liberating nutrients for assimilation by the algae. Algae, in turn, liberate oxygen used by bacteria.

Algae are harvested and the innocuous waste discharged. The California scientists get photosynthetic efficiencies of 5 to 8% in their pilot ponds, with yields of 30 to 35 tons (dry weight) per year per acre (low because of foggy days in the San Francisco Bay region; July-August yields are at a 65-to-70-ton-per-acre yearly rate). The material runs 45 to 60% crude protein, 10 to 20% fat, 15 to 25% carbohydrate, and 10 to 20% ash (dry basis).

Meanwhile, others at University of California are looking at algae for another purpose—nitrogen fixation. Mary B. Allen, Daniel Arnon, and others have been pegging down nutrient requirements of blue-green algae which have this important property. Potentialities lie in using blue-green algae in rice fields for maintaining nitrogen fertility, according to Dr. Allen. In laboratory scale experiments, she finds *Anabaena*

cylindrica fixes gaseous nitrogen in an organic form equal to 480 pounds of nitrogen per acre per month. While speculative, this figure compares to the legume-rhizobium combination which contributes about 200 pounds of nitrogen per acre per crop.

Hydrocarbons from Algae

Yet a third approach to algae use is suggested by R. L. Meier, University of Chicago, who sees algae as a potential future source of liquid hydrocarbon fuels. Meier proposes an algal culture similar to Oswald and Gotaas's waste disposal system. This would give a slurry containing 4 to 6% algae, and the slurry would then be fermented anaerobically to convert some 60 to 80% of the caloric content to methane and hydrogen. The methane could be liquified for sale as a fuel, or it could go to a Fischer-Tropsch hydrocarbon synthesis unit to make a variety of chemicals. The residual liquids from the fermentor could serve as a fertilizer solution. Meier estimates an annual hydrocarbon yield of some six to 14 tons per acre, with cost falling in the \$150 to \$400-per-ton range.

When?

Big question, of course, is how soon these and other applications will find widespread use. Initial investment is a big hurdle, especially in countries where some solar energy applications could operate competitively today. A solar oven can be made and sold in India for \$16, but the class of persons who could benefit most has slim chance of accumulating such a sum; solar pumps based on designs of today could be pumping irrigation water in some semiarid regions of the world, but capital isn't available in these regions.

As Farrington Daniels sees the future, "Too many people are beginning to expect too much too soon. There is no sudden era of solar prosperity just around the corner." Much work remains to be done.