SCIENCE
30 August 1963
Vol. 141, No. 3583
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

CLOUDS IN LINE

IBM computers, science and you:

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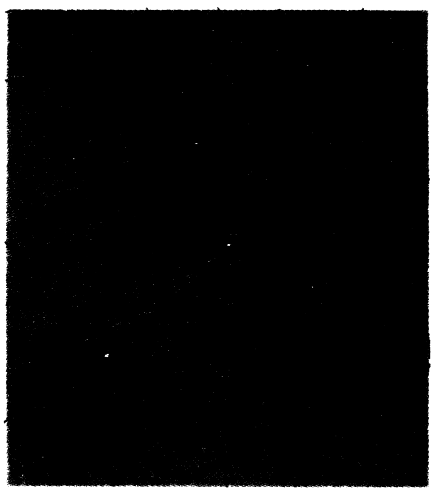

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DATA PROCESSING

30 August 1963
Vol. 141, No. 3583

SCIENCE

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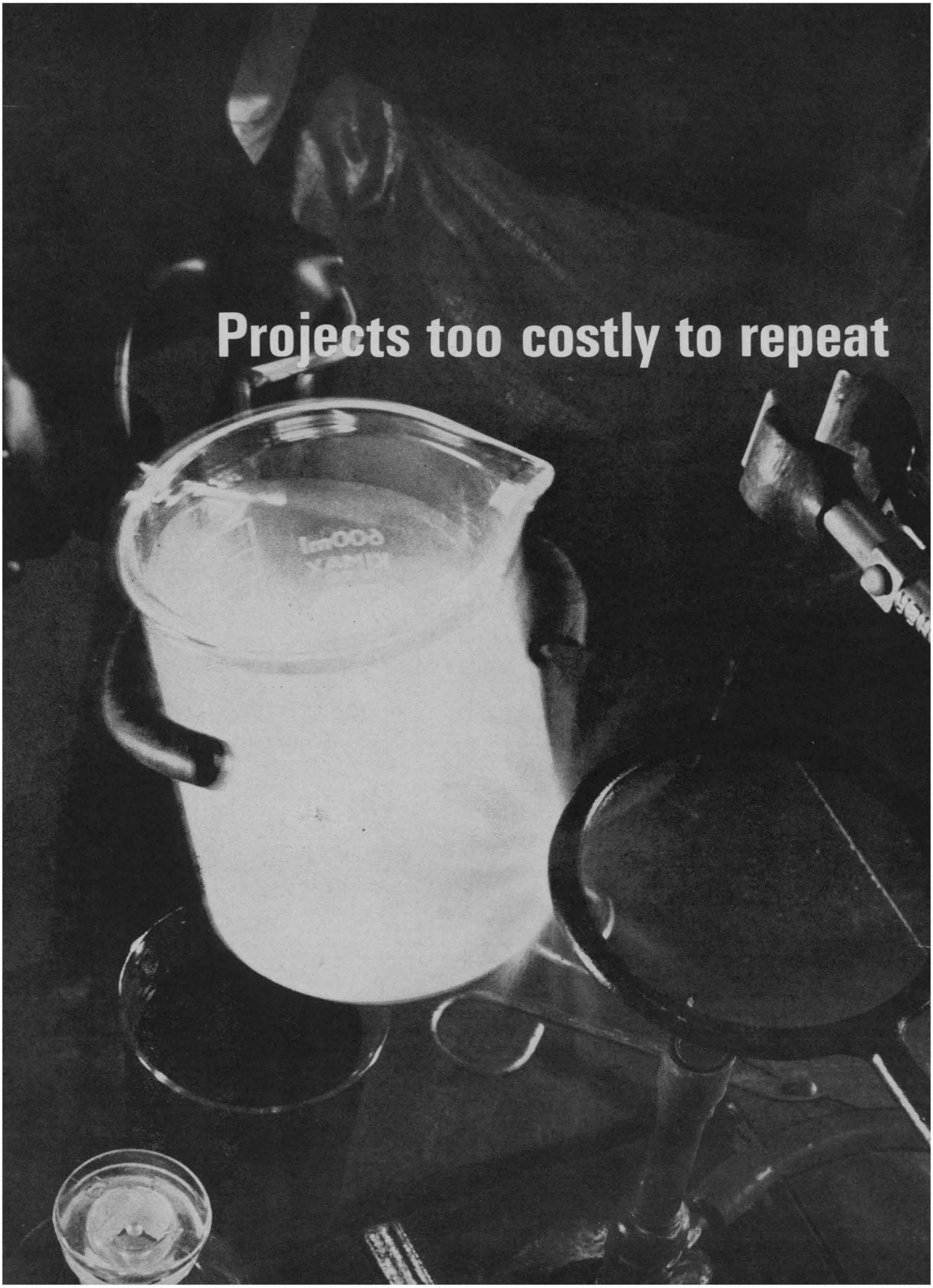
COVER

Cumulonimbus cloud towers in an anticyclonic disturbance over the Pacific Ocean just east of Wake Island, 0637 G.C.T., 17 August 1957. The line of towers extends southwest or west-southwest, with a maximum height of 9000 meters. The disturbance, which was part of a large trough extending from middle latitudes to the tropics, later developed into a tropical storm. Camera aimed south; aircraft altitude, 2400 meters. See page 767. [Claude Ronne, Woods Hole Oceanographic Institution]

Projects too costly to repeat



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(End of Computers)

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The New versus the Classical in Science

There long has been a bandwagon tendency in American science, but today it seems particularly rampant. This seems true of the physical sciences and particularly of the biological sciences. In addition, there is an inclination to equate "classical" with "old-fashioned" and "passé."

We Americans worship the new: Madison Avenue bases its approach on this weakness of ours. This is why car manufacturers bring out new models each year. Somehow the word *new* has acquired the meaning of "better." Even scientists have succumbed to this psychology. Whenever there is a new breakthrough we tend to abandon the previously active areas. A massive follow-up of new discoveries is normally highly productive, and no damage would be done if it were not for the fact that the abandoned fields are rarely exhausted. When talent is diverted from them, science suffers an irreparable loss of know-how in the form of specialized information and methodology.

At this very moment, in some classical branches of science it is impossible to find a single expert. In others, the number of well-trained and intelligent specialists is smaller than the number of available hard-money positions. Invertebrate zoology (in its various subdivisions) is now in this position, and probably most specialists could name other fields.

This development is accompanied by other trends. The most imaginative workers are those who have been attracted to the new efforts and have thus automatically left the more orthodox workers in command of the classical fields. Bright young students quite naturally look for the greenest pastures. Recruitment thus becomes a serious problem. This is aggravated by the attitude of the Young Turks in the new areas. They tend to regard the more classical branches of their science with unconcealed contempt. At worst, this intolerance leads them to attempt to cut off funds from the more classical fields. The situation is further aggravated by the attitude of some foundations and science administrators. They are justified in fostering exploitation of breakthroughs, but it seems unwise for them to pour most of their funds into the glamor fields. The follow-up of breakthroughs rarely requires large foundation support. The bandwagon tendency takes care of this automatically.

Far more important, for the general well-being of American science and the attainment of a healthier balance between classical and frontier fields, is more financial and moral support for the classical areas. We should not place unnecessary obstacles in the path of the bright, imaginative youngster who, for reasons of his own, wants to go into an unpopular, classical field, because precedent shows that he is quite likely to make a spectacular success of it. The total *Zeitgeist* of science, together with new models and new techniques, moves ahead so rapidly that someone who has grown up with these new ideas very often finds unexpected new approaches in the "old" field and helps to rejuvenate it. The new systematics, and other, similar developments, show that this can be done, and that such rejuvenation has beneficial effects that go well beyond the focus of the renaissance. This would happen oftener if the principle were accepted more broadly that the new should supplement the classical and not totally displace it.—ERNST MAYR, *Museum of Comparative Zoology, Harvard University*

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Lively and continuing discussions took place as the delegates joined in the exploration of the highly involved interactions of plant roots, soil, saprophytic soil microorganisms, and plant pathogens. The ultimate objective of the symposium was the subjugation by biological means of soil-borne pathogenic viruses, bacteria, fungi, and nematodes. In essence, this was a search for new approaches and new ideas on how to attain control of such groups of soil-borne plant pathogens through biological techniques and an attempt to define the areas where additional research is most needed.

The underlying encouragement which motivated the symposium has come from instances of biological control which have proven successful and, more than this, sometimes spectacular. This has been especially true where chemical control has not been economically feasible and suitable resistant varieties of plants have not been available.

One of the oldest biological approaches to control disease on pathogen-infested land has been to resort to different crop successions or to turn under various green manure crops to allay damage from diseases anticipated in a succeeding crop. This technique has met with notable success in certain regions against specific diseases. For example, it is reported that phymatotrichum root rot of cotton in the Southwest is being successfully combated by disking into the soil an immature crop of peas in the spring, prior to planting cotton. Ophiobolus root rot ("take-all") of wheat may be controlled by rotating a crop of oats with the wheat.

In California streptomyces scab of potato is effectively kept in check where the crop is grown on the same land year after year by growing a crop of soybeans in the fall after the potato harvest and turning it under before the crop matures. Sclerotium rot of peanuts is prevented in the South by avoiding the presence of undecomposed organic litter in the top few inches of soil. A serious Fomes rot of rubber tree crowns and roots in the tropics is being kept under control cheaply and rather spectacularly by biological means. A particular variety of legume is grown as a ground cover in rubber plantings where the disease has appeared. The pathogen appears to dissipate its energy on the legume without doing any real damage to either the legume or the rubber trees.

On the other hand, many crop rotation and cover-cropping systems either fail in disease control or actually make the disease worse.

An objective of the symposium was to seek out the mechanisms involved in biological control in soil and to understand the circumstances which make for success on one hand and failure on the other. Knowledge of the mechanisms involved in the soil-pathogen-host relationships would enable a more intelligent approach to the control of soil-borne diseases through biological means.

Several aspects were selected for greater research emphasis. It was brought out, for instance, that the behavior of the host plant in terms of root diseases may be manipulated to some extent by sprays, fertilization, time of planting, and so forth. Since root exudates are known to be important in initiating the activity of root parasites, it follows that cultural practices which influence the amounts and quality of these exudates are important in the inception of disease and in its avoidance.

Since most pathogens in soil are in a resting rather than a vegetative condition, it is clear that the manipulation of soil likewise may be important. More information is needed on the factors which influence the survival, multiplication, and parasitic activity of the pathogens in soil. Stimulation of the pathogen into activity in the absence of its host may waste the reserves of the organism and decrease its population in soil. Certainly it became clear that the specific roles of plant exudates and plant residues in nature need clarification.

Many discussions centered about the role of natural openings in roots in relation to pathogen entry. Ruptures at the point of root emergence, the senescence of transient roots, and certain features of the root surfaces themselves were considered as possible portals of entry. It is surprising how little information is available on root anatomy and physiology in relation to pathogen entry and development.

Investigators from different disciplines were made aware of the overall problems in the biological control of root diseases and most had valuable suggestions to offer.

Critically deficient lacunae in our knowledge of the interactions of soil, plant, and soil microorganisms in relation to the activity of root pathogens were pinpointed.

It became apparent that although biological control, as treated here, could be and at times is accomplished by di-