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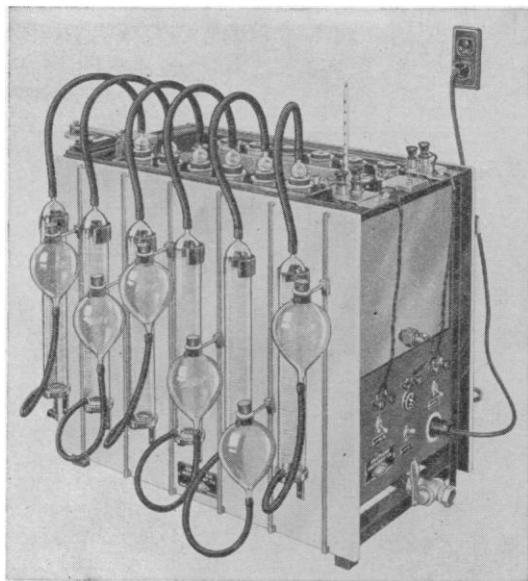
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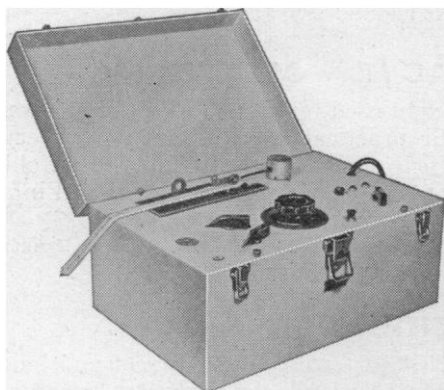


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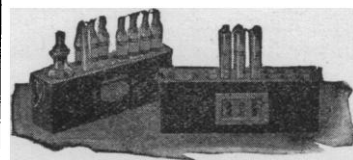


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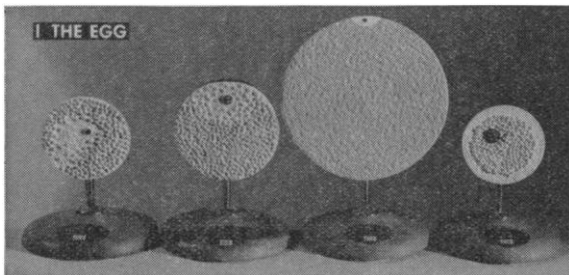
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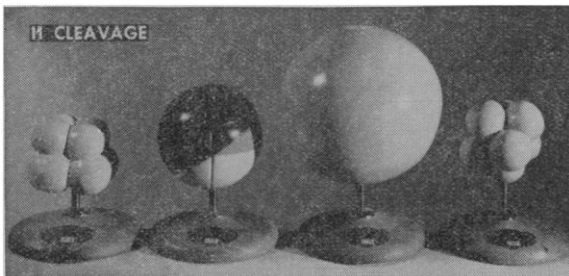
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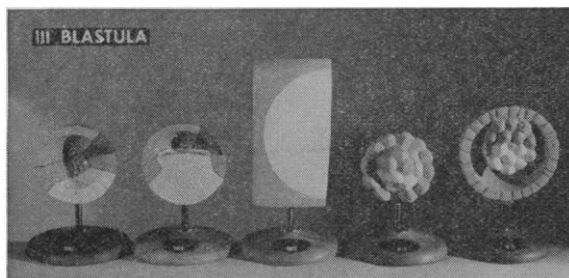
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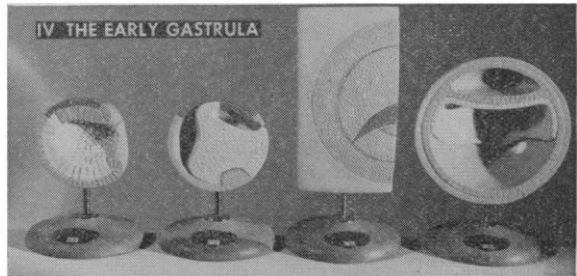
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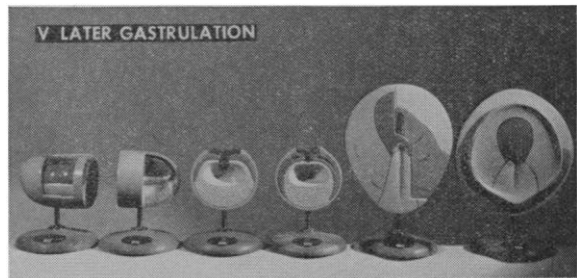
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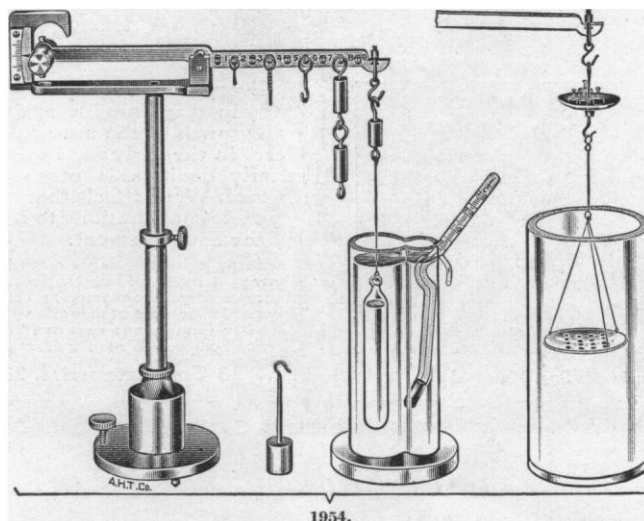
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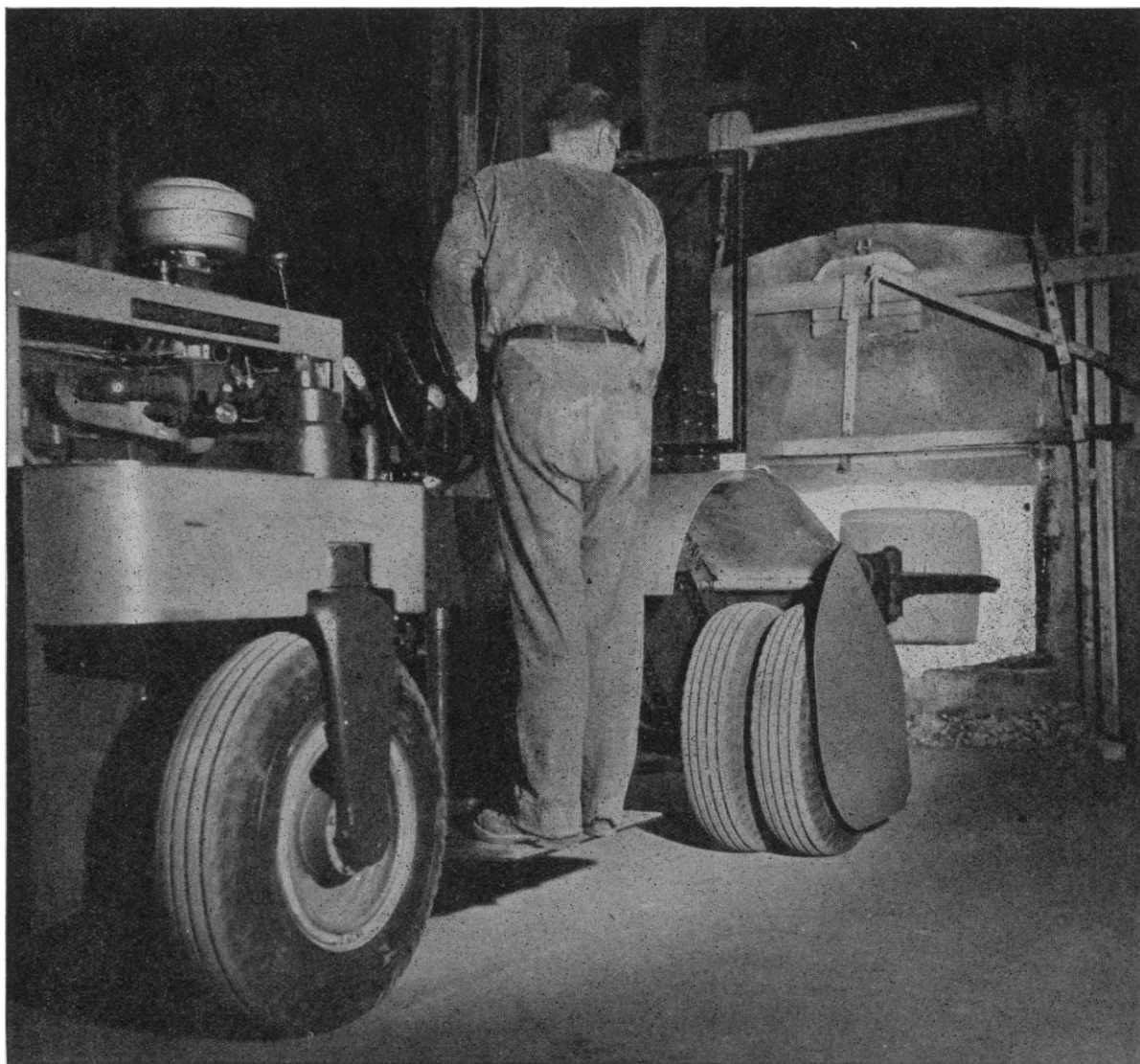


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FUTURE SOURCES OF POWER¹

By Professor C. C. FURNAS

YALE UNIVERSITY

THE sun's rays shower as much energy on the earth's surface in one minute as the entire human race utilizes in one year. Despite the presence of this bountiful and unusual flow of energy, a large part of the struggles of the human race are concerned with acquiring and controlling sources of power. Evidently our state of development in the utilization of power is still rather crude. A review of the various practical sources of the present day is in order.

PETROLEUM

The energy supply which is most critical in America is that of petroleum. At the present time we are

¹Summary of an address before a joint meeting of the Rochester, Syracuse and Cornell sections of the American Chemical Society, Rochester, N. Y., October 4, 1941.

using considerably over a billion barrels per year. The known proved reserve of petroleum in the ground is 14 to 17 billion barrels, depending on who does the estimating. Thus the petroleum actually in sight is only about a twelve-year supply. But new discoveries are being made constantly so most of the people in the petroleum industry say they are not worried about the supply, at least for the present generation. It is a little discouraging to note, however, that the new discoveries are not quite keeping pace with use so the pinch of partial depletion may come sooner than the optimists anticipate.

There may be discoveries of great new fields, but the prospects of that are not very good. There is the possibility of extensive fields lying under the ocean

cleaner motor provided sufficient suction for our purposes. Inlet tubes were specially constructed with one-half inch bore and with the submerged end a perforated bulb of the bubbler type to prevent clogging or unequal pressure from the glass beads.

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Tests on the efficiency of this machine by attaching it in series to the Wells Air Centrifuge, and tests where two of the bubbler pumps are set up so that the exhaust of one is attached to the inlet of the other reveal that bacteria of air samples are more thoroughly absorbed by the bubbler pump than the air centrifuge. Table 1 shows the magnitude of this difference in

TABLE 1
RELATIVE EFFICIENCY OF THE BUBBLER PUMP AND AIR CENTRIFUGE AS SHOWN BY AIR SAMPLES FROM THE APPARATUS CONNECTED IN SERIES

Apparatus	Unit	Colony counts			
		1 ml.	2 ml.	Estimated colonies av. in 50 ml.	Count in 10 cu. ft.
(A) Two bubbler pump units in series.	Pump No. 1	5	8	225	990
	Pump No. 2	0	0	0	0
(B) Centrifuge in series to the outlet of the bubbler pump.	Pump	6	10	262	1,190
	Centrifuge	-	-	-	1

The above experiments were conducted in the same room on the same day.

colony counts when the machines are arranged in series. When separate runs are made in the same room by the two machines colony counts indicated by the bubbler pump are usually several times that found in an equivalent sample of air from the centrifuge. Table 2 shows sample protocols of such runs.

Preliminary experiments indicate that accurate evaluations of the bacterial content of air under the

TABLE 2
COMPARISON OF BACTERIAL COLONY COUNTS IN AIR SAMPLES: PARALLEL RUNS IN AIR CENTRIFUGE AND BUBBLER PUMP

Room	Color counts		Av. colony count for 50 ml. broth	Estimated colonies: 10 cu. ft. bubbler pump	Air centrifuge: Colonies counted in 10 cu. ft.
	1 ml.	2 ml.			
Ward F ...	3	7	162	710	86
Ward E ...	3	14	318	1400	108
Ward H ...	3	5	137	610	58
Room 63 ..	3	5	137	610	170

natural conditions of a hospital ward are possible with these bubbler pumps. Experiments are in progress involving the correlation of dust and bacteria counts and the effect of ultra-violet rays on the bacteria of irradiated rooms.

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FENN, WALLACE O., Editor. *Muscle; Vol. III, Biological Symposia*. Pp. 370. Jaques Cattell Press, Lancaster, Pa. \$3.50.
GILBERT, NORMAN E. *Electricity and Magnetism; Theory and Applications*. Second edition, revised. Pp. xvii + 585. 394 figures. Macmillan. \$4.50.
MEYER, BERNARD S. and DONALD B. ANDERSON. *Laboratory Plant Physiology*. Second edition, revised. Illustrated. Van Nostrand. \$2.00.
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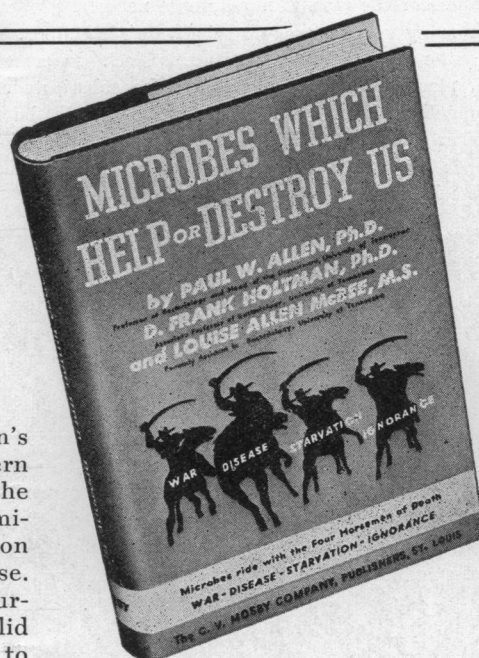
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MICROBES WHICH HELP OR DESTROY US

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