AN EXPERIMENT WITH A VERTICAL SOLAR STILL

by

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In the present paper a solar still of a new design is described.[1] It is characterized by a vertical structure; in general, solar stills consist of assembled horizontal trays containing the salt water and covered by a tight inclined glass roof.

During the Saline Water Symposium held in Washington, D.C., in November 1957 [12][2], Dr. Wilson of the Commonwealth Scientific and Industrial Research Organization of Melbourne, Australia, described a solar still in which four trays were assembled one upon the other in a room surrounded by glass plates.

Such stills have been designed in order to collect the solar radiation when the inclination of the sun is low, as is the case in the arctic regions.

The author of this paper has extended this design and has built the solar still illustrated in Plates XXI and XXII. There are four rectangular trays, each $1 \times 3 \times 0.13$ ft. (3 sq.ft.) assembled in a glass cage closed at the bottom by an inclined iron plate. The trays are made of aluminium, electrolytically blackened.

The distance between the trays is about 10 inches. The trays are surrounded by hot still air and this ensures good insulation for the water heated by the solar radiation and minimizes the heat losses through the bottom of the trays; such losses may be great in horizontal solar stills.

The orientation of the still is east-west, with the inclined face oriented to the south.

The water to be distilled is introduced in the first upper tray through an inlet tube and then passes into the lower trays. The heat of the sun is absorbed by the water in the black trays; the water evaporates and the water vapour condenses on the inner surfaces of the glass cage; it is collected at the bottom and then in the measuring vessel.

The preliminary results for the first two months of experimenting are contained in fig. 1, representing the daily water production in relation to the daily sun radiation on an horizontal surface.

From this graph it appears that about 550 BTU/sq.ft./day are necessary to warm the still in order that distillation should begin.

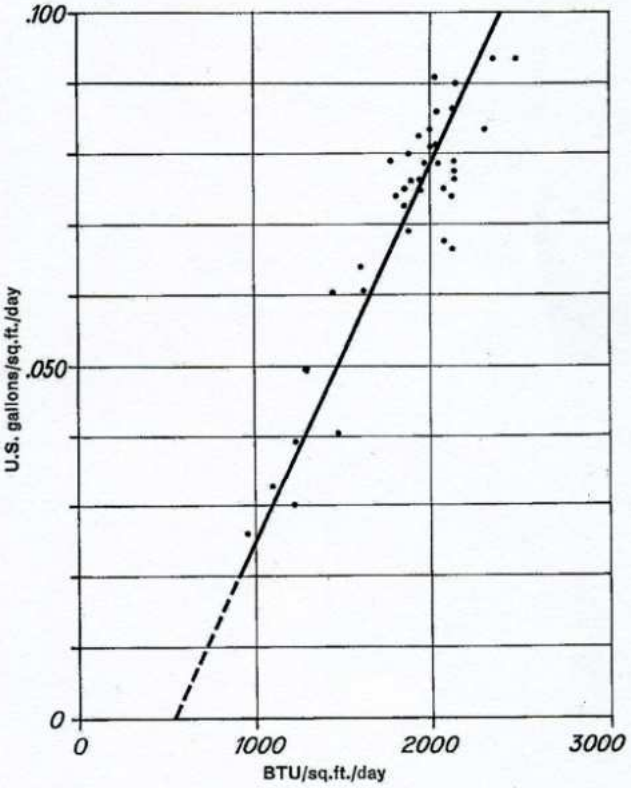

FIG. 1. Daily water production in relation to daily sun radiation on an horizontal surface (2-month period).

When the distillation has begun, a further 1,850 BTU (approx.) of solar energy are required to distill 0.100 U.S. gallons of water. This represents a utilization of 50 per cent of the incident radiation, considering that

1. This is the experimental solar still, model No. 7. For other experiments see publications referred to under 4, 5, 6, 7, 8, 9, 10 in the bibliography on page 385.
2. The figures in brackets refer to the bibliography on page 385.

in a simple distillation process, operating at atmospheric pressure, about 9,200 BTU are required per gallon of distilled water.

All these considerations refer to the whole surface of the trays, i.e. 12 sq.ft.

However, the tray surface reached by the solar radiation varies greatly at the different hours of the day; it is about 12 sq.ft. until the inclination of the sun is lower than 35°; when this inclination increases the upper tray is always exposed but the lower ones are decreasingly exposed, being shaded by the others.

The amount of distilled water per unit of covered ground is very large.

Its evident efficiency and the simplicity with which it is assembled suggest that the vertical still is a promising device for distilling saline water.

RÉSUMÉ

Compte rendu d'une expérience portant sur l'emploi d'un distillateur solaire "vertical" (G. Nebbia)

On a expérimenté un distillateur solaire dont les plateaux sont placés dans la position verticale — et non horizontale comme ils le sont d'habitude — en vue de réduire les pertes de chaleur qui se produisent à travers le fond et de diminuer la superficie occupée par l'appareil.

L'eau salée est contenue dans quatre plateaux de 0,27 m² chacun et placés dans un espace clos de plaques de verre.

Les plaques de verre et les plateaux sont montés sur un châssis de fer; les plateaux sont en aluminium noirci.

L'auteur indique quelles quantités d'eau ont été obtenues et il commente les résultats de cette expérience.

DISCUSSION

C. Gomella. Quelle a été la méthode de calcul utilisée par le professeur Nebbia pour déterminer l'énergie rayonnante réellement reçue par l'appareil?

Avant d'écouter la réponse du professeur, je voudrais ajouter que le très intéressant appareil décrit est particulièrement adapté aux pays de latitude élevée, alors que, près de l'équateur, seul le plateau supérieur recevrait une quantité notable d'énergie.

G. Nebbia. (1) The solar energy intensities are available to me through the courtesy of the Italian Air Force, which has established a network of heliometric stations in Italy. The data of the Bologna station are elaborated at the Meteorological Office of the Air Force and then are made available to me.

(2) The figure of 50 per cent for the proportion of solar energy used has been calculated as follows:

About 1,500 Kcal./mg./day are necessary to heat the still. When the distillation has begun it is possible to observe the following data (average) which refers to the total surface of all four trays:

l./mg./day[1]	Kcal./mg./day[1]
2	4 000
2.5	4 600
3	5 200
3.5	5 800

Since about 600 Kcal. are necessary to evaporate 1 litre of water at 70°C., and since an increment of 600 Kcal. in solar radiation caused an increase in water production of about ½ litre, I have stated that the percentage of incident solar energy used for distillation is about 50.

(3) I agree completely with Dr. Gomella's observation that the utility of the still would be greater in temperate zones.

G. Drouhin. M. le professeur Nebbia a-t-il fait quelques mesures pour déterminer les rendements respectifs des plateaux successifs?

G. Nebbia. No. I have available only the maximum temperatures of the trays, from top to bottom, from 12.00 to 14.00 hours. They are about 65–70, 55–60, 45–50 and 35–40° C. respectively, with external air temperatures of about 30–35° C.

R. Ambroggi. Le professeur Nebbia peut-il préciser:

(1) Depuis quelle date cet appareil est en fonctionnement? Depuis quel mois?

(2) Quels sont les meilleurs rendements obtenus?

G. Nebbia. (1) The solar still data have been collected since June 1958. For June and July solar energy intensities are now available and correlation is possible. The still is still working (October 1958); complete correlation between water production and solar energy intensity will be available in the future.

(2) The best results are:

Date	Water production per 1.08 sq.m.[1]	l./sq.m./day	Solar energy intensity Kcal./sq.m./day
29. 6. 58	4.15	3.8	6 700
3. 7. 58	4.15	3.8	6 370

1. Surface of all four trays.

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