point. To work at higher voltages, use more than one cell and connect them in series. If you need more current than one cell can produce, connect several cells in parallel. The battery used on the Americus, Georgia, Rural Telephone Test* had 432 solar cells connected in 6 parallel banks having 72 cells joined in series. It charged a 20-volt storage battery delivering about ⅓ ampere in bright sunlight. Of course, it delivered less current in partial sunlight, but being properly matched to the load, it gave the most power it was capable of producing for any condition of sunlight.

Efficiency

Let us define what we mean by per cent efficiency and then measure the efficiency of your cell. The efficiency we are interested in is the percentage of the total solar radiation that appears as electrical power in the external load. The power into the load is simply the product of cell terminal voltage and current as already computed in our study of load curves. The total solar radiation is the solar constant (which we discussed in Chapter 1) times the active area of your cell. Measure and compute as best you can, the exposed active area. Unless you have a pyroheliometer† make the test on a clear day near noon and assume that the solar constant is 0.1 watt per square centimeter. Input power is $C \times A$, where C is the solar constant and A is the active area of your cell perpendicular to the sun's rays. Take the output power and divide it by the input. This fraction, reduced to percentage, is the efficiency of your cell.

In January, 1954, the solar cells we were making at Bell Telephone Laboratories had an efficiency of conversion of 4%. By the time the cells were announced to the public in April of the same year, we had reached 6% efficiency. A year later, an 11% cell had been made; there have recently been reported cells of 14% efficiency. What can we expect as a reasonable upper limit? A calculation of 22% was made based on reasonable assumptions. The 22%, calculated as a figure

* The first field trial of a rural telephone system making use of transistors and the Bell Solar Battery was held in Americus, Georgia. The Bell Solar Battery was installed on a part of this trial system in October, 1955, as an experimental substitute for ordinary batteries. Bell System engineers have ascertained from the Georgia tests that, from the standpoint of reliability and effective operation, the Bell Solar Battery mounted on a pole can be used to furnish electricity for rural telephone equipment. However, until raw material, technology and electrical storage become less expensive, it will be more economical to use conventional power sources for telephone systems.

† Calibrated instrument for precise measurements of solar radiation.