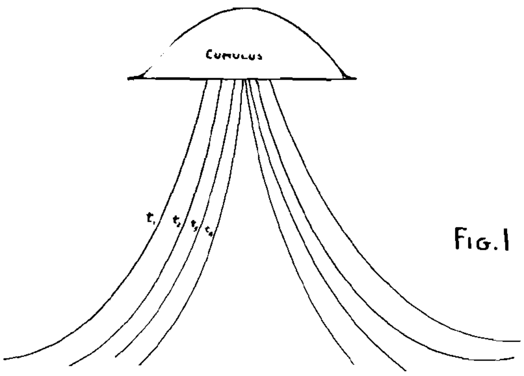

Fig. 1

that the difference between the outside and the core of a thermal must be several degrees. He estimated the figure from the power which a thermal develops. On the other hand the upper limit is not greater than several degrees for if it were, pilots could feel the change in the air temperature very easily.

Now if one had a very sensitive, low lag thermometer on his ship as he passed through a thermal, and if one were to plot the temperature against position with respect to the center of the thermal, the curve in Fig. 2 would be obtained.

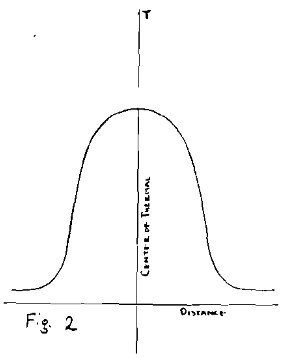

Fig. 2

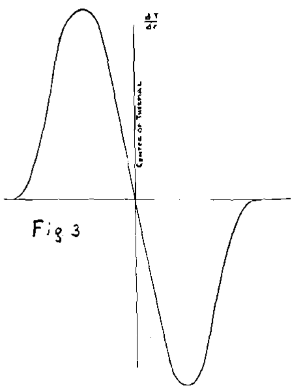

Fig 3

By utilizing the equations Mr. Platt of NACA developed in 1938, one could fly in this thermal to secure a maximum lift. There are, however, a few obvious disadvantages to using this technique. If now instead of measuring absolute temperature we merely simultaneously measure the difference in temperature between two points in the thermal at the same time, we should obtain what is defined as the temperature gradient. The gradient is strictly a vector $\frac{dT}{dr}$, where dT is the change in temperature and dr is the change in position required to produce the change dT. We can easily obtain the gradient curve from Fig. 2 by merely plotting the slope of the curve in Fig. 3.

In field measurements it may happen that the position of maximum gradient will be the position of maximum lift although it will be necessary to include in this determination the variation of sinking speed of the sailplane with radius of turn.

PART II

The Technique of Measuring Temperature Gradient from a Sailplane

In a previous article in SOARING[1] the basis of geophysical prospecting for vertical convection in the atmosphere was developed. This discussion will be confined to the instrumentation involved in the process of locating thermals by means of their temperature gradient. To obtain a reading of temperature gradient we merely measure the temperature at two adjacent points and divide the difference in temperature by the distance between the two points. Here it must be stressed that the temperature so measured is not just so many degrees centigrade per thousand feet but we must also specify that the direction of the gradient is in the direction of increasing temperature along a line between the two points of measurement. The following discussion will be limited to measurement of $\frac{\Delta T}{\Delta y}$ along the wing span, since the technique of measurements along the fuselage is obviously an identical problem. While there are many ways of measuring temperature, there are few of them specifically adapted to sailplane work. As a general rule the ordinary thermometers are far too sluggish and insensitive to measure the small temperature differences. In order to get a measurable difference in temperature, the thermometers should be placed on the ship as far apart as possible. This automatically decides for us what temperature measuring system we must use. Since we must measure the temperature at two remote points (wing tips) and take the reading at a third position (the cockpit), the logical device will be one which translates temperature into changes of electrical current or voltage. This selection has other fundamental advantages:

1. Ease of transmitting readings to the cockpit by means of wires.

2. Availability of sensitive meters for measuring currents of small magnitude.

3. The difference in the temperature of the wing tips is obtained by simply connecting the thermometers so that the currents buck each other. Since the distance between points of measurement is fixed, it is a simple matter to calibrate the instrument in terms of gradient.

One of the electrical methods which looked promising from the standpoint of stability and high sensitivity is shown in Fig. 4. It is a common Wheatstone bridge circuit with two of the arms made of resistance wires having a high temperature coefficient of resistance. These units are placed at the wingtips with their elements exposed to the free air flowing past the wingtips.

This circuit can be mathematically analyzed and con-

[1] Thermal Sniffers by Mabel Raspet, Soaring, December, 1939.