laboratory galvanometers in order to read these minute currents. Specifications on the various galvonometers shows the mirror type to be about 10 times more sensitive than the needle type. The former is also the more sturdy on account of its movement being of smaller mass. But with the mirror type there are two disadvantages, namely the difficulty of reading in bright sunlight and the necessity of carrying batteries for the lamp, yet there is one rather infrequently used type of galvanometer which lends itself well to aircraft galvanometric work and that is a string galvanometer. This type is very rugged, and probably would survive any forced landing. It can also be made extremely sensitive. In its present laboratory form it is very bulky and heavy and some development work would have to be done before it could be used in sailplanes.

As has previously been mentioned, the resistance of the galvanometer should be selected so that it equals the resistance of the thermocouples and lead wires. Under this condition, maximum deflection is obtained.

A Directive Gradiometer

In the isothermal contour of a hypothetical convection current assume a sailplane to be flying as shown in Fig. 8. Then the fore and aft gradient will be designated $\frac{d\Phi}{dx}$ and the lateral gradient as $\frac{d\Phi}{dy}$. These are measured on two simple gradiometers arranged in the respective directions. By simple vector addition, Fig. 9, of the gradients one obtains both the magnitude and the direction of the normal gradient. The magnitude is given by $\sqrt{\left(\frac{d\Phi}{dy}\right)^2 + \left(\frac{d\Phi}{dx}\right)^2}$. The direction by $\text{TAN}^{-1}\frac{\frac{d\Phi}{dy}}{\frac{d\Phi}{dx}} = W$. It is not necessary for a pilot to carry a

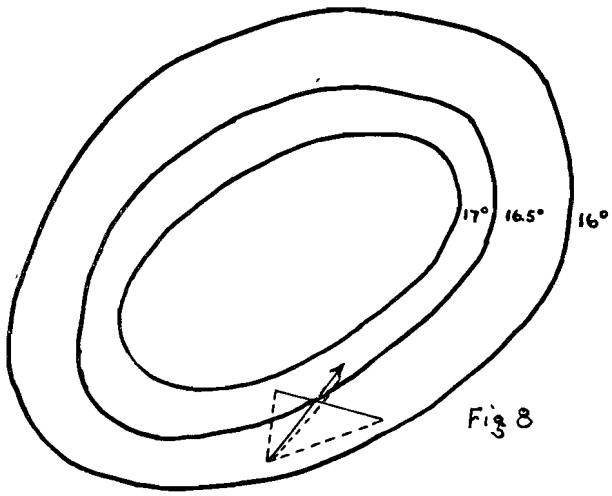

Fig 8

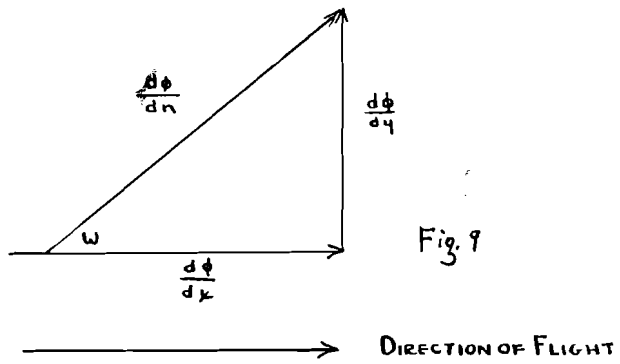

Fig. 9

slide rule or a computing machine to determine the structure of a thermal. If one merely orients his galvanometers as in Fig. 10 he can readily see that the maximum in temperature is situated forward and to his left. After he has turned his ship normal to the isothermals, his lateral gradiometer will read zero and his longitudinal will read a large positive value. If, after flying for some time, his gradiometer begins declining, he will have

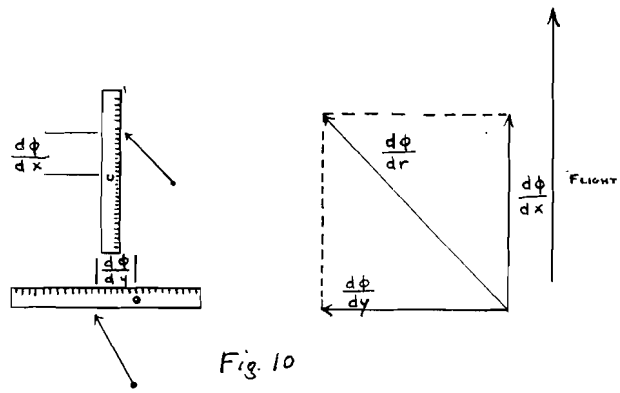

Fig. 10

passed through the center of the thermal. Now to obtain maximum lift after passing through the center he turns until his lateral gradient becomes a maximum and his longitudinal zero. He is thus following one of the isotherms.

It may appear complicated but if further research warrants, it is possible to build a galvanometer which will

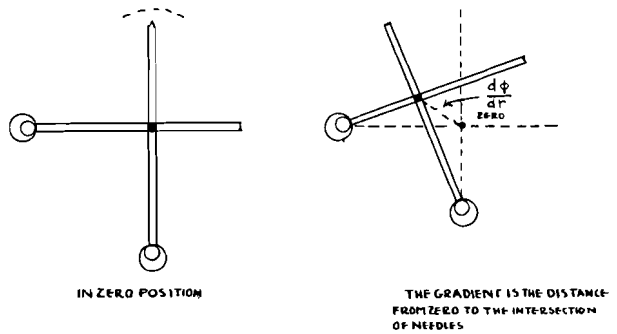

Fig. 11

(*Continued on page* 12)