Why Subterranean Isobars?
The 5000-Foot vs. Sea-Level Chart over the Plateau Region

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ABSTRACT

Five-thousand foot isobars are argued for again for the plateau area. The argument brings in typical examples which show comparatively the value of one system against the standard procedure.

It has long been recognized that the sea-level pressure for an isolated mountain station is often sharply out of line with the sea-level pressure for surrounding stations at lower altitudes. The discrepancy is, of course, attributable to the accumulative effect of reduction through a fictitious air column of considerable depth when the assumed lapse rate and temperatures in the imaginary column are in disagreement with the conditions in an actual air column nearby.

Since most of the earth’s surface in the western half of the United States is several thousand feet above sea-level, it logically follows that sea-level isobars in the western plateau are as poor a representation of actual surface pressure gradients as the reduced pressure at the isolated mountain station. Yet with scarcely an exception, weather maps which are supposed to portray the ‘surface’ synoptic situation, carry sea-level isobars from coast to coast. These fictitious pressure gradients for a level a mile underground are very often a misrepresentation of the surface pressure gradient as indicated by the 5000-foot winds and weather.

In 1934, D. M. Little and E. M. Vernon of the U. S. Weather Bureau demonstrated the greater value of 5000-foot isobars over the plateau. Earlier, the problem of correct isobar patterns in the plateau had been discussed by Abbe in 1882, Bigelow in 1901, and Meisinger in 1922. Little and Vernon pointed out inconsistencies between sea-level and 5000-foot pressure patterns and mentioned that there were instances in which weather and winds over the plateau were in agreement with 5000-foot isobars, but in disagreement with sea-level isobars. Their paper expressed the opinion that use of sea-level isobars over the plateau have even resulted in a belief that the commonly accepted relationships between pressure fields and weather held only to a limited degree in this area.

As any person who has regularly analyzed the 5000-foot pressure field will testify, any such misconceptions formed because of sole use of the sea-level isobars in the plateau are refuted by correct analysis at the surface. Why, therefore, do weather offices throughout North America still draw surface maps, a large area of which are false?

One solution to the problem of portraying the true pressure field over the plateau which has been used to a limited extent, has been to draw the 5000-foot isobars on a separate chart. This method, however, still leaves the surface weather data on the base map with the fictitious and usually misleading sea-level isobars. [The 850-mb chart can be substituted for the 5000-foot chart now that constant-pressure analysis is generally used.—Ed.]

In this country, United Air Lines meteorologists have for several years been drawing only 5000-foot isobars for the plateau on their base weather maps. Considerable ex-
experimentation was conducted before deciding upon the following method of representing the surface pressure field: The 5000-foot isobars are drawn in green and the sea level isobars in black. The sea-level isobars extend to the edge of the plateau area. At the meteorologists' option, some overlap is allowed by extending the 5000-foot isobars over sea-level isobars in some areas, such as eastern Washington, eastern Montana, southwestern Arizona, and central California. The underlying sea-level isobars are dashed in this case as a further aid in distinguishing between the two pressure fields. (See Chart V.)

To call attention to the advantages of

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In southern Wyoming the 5000-foot winds which give the true air flow of lower levels are in much better agreement with the 5000-foot gradient than with the steep sea-level gradient.

The sea-level Low in southern Nevada and the sea-level High in southeastern Arizona are not borne out by the winds in that area. The actual wind is in closer agreement with the 5000-foot isobar pattern.
replacing the sea-level isobars with 5000-foot isobars in western United States, the following charts have been selected as typical examples. Winds at 5000 feet msl have been included on these charts as representing the actual air flow over the plateau, although it must be recognized that the flow at this level is occasionally disturbed by nearby orographic features. On Charts I to IV, inclusive, 5000-foot isobars are shown as solid lines. On Chart V, a different convention is used, solid lines being sea-level isobars and the dotted lines representing the solid green 5000-foot isobars.

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The actual circulation agrees better with the 5000 foot high pressure ridge than with the sharp sea-level ridge extending from British Columbia to southern Idaho. The sea-level gradient in Arizona is also too strong for the observed winds, but the 5000 foot gradient here is in good agreement.
The 5000-foot isobars conform to the winds in central Utah and central Colorado. The steep sea-level gradient in this area appears in sharp contrast to the actual conditions.

The observed 5000-foot winds (and surface winds, not shown) agree with the 5000-foot trough on the lee side of the Rockies from Montana to northeastern Colorado. The sea-level trough here is much deeper.

In Arizona the 5000-foot pressure gradient agrees with the observed wind much more closely than does the tighter sea-level gradient for the same sector. The sea-level gradient here should produce a geostrophic wind of about 40 miles per hour whereas no such wind existed at any level below 10,000 feet msl in Arizona.
The packing of sea-level isobars in the high country extending from northern Idaho to southeastern New Mexico presents a false picture of the true air flow as evidenced by the relatively weak winds at 5000 feet. Except for the area near the Great Salt Lake, the 5000-foot isobars appear in much closer relationship to the actual wind speeds.

Note that the 5000-foot flow has crossed the center of a small sea-level High based upon several "calculated" sea-level pressures from southeastern British Columbia.

The cold front in western United States fits the 5000-foot trough. This trough does not show up in the sea-level pattern through Oregon, and the front actually crosses a small secondary High in the fictitious sea-level isobars.
Once use is made of the 5000-foot pressure field without the detraction of misleading sea-level isobars there is no longer any doubt as to the most accurate representation of the surface pressure configuration in the plateau of western United States. Fronts, trough and wedge lines, and pressure centers can be followed from map to map with logical continuity as contrasted to sudden and erratic changes in the pressure field notoriously characteristic of the sea-level pressure pattern in the high country. Once the initial resistance to change from an old convention is overcome, the fallacy of mile-deep isobars becomes readily apparent to the user.

Typical United Air Lines map showing combination of 5000-foot isobars over plateau and sea-level isobars elsewhere; the winds are plotted for 5000 ft. msl over the plateau and for 1500–2000 ft. above the ground elsewhere.

**CHART V**

(1130 MST, March 23, 1946)

This example is included to illustrate the method of drawing United Air Lines weather maps for indicating more closely the true pressure field at the surface without sacrificing clarity. The winds shown on this chart are for 5000 feet msl over the plateau and for 1500 to 2000 feet above the ground elsewhere. (On UAL working charts, winds for the surface and several levels up to 10,000 feet are also included in appropriate colors.)