

**A MANUAL, CONTAINING TABLES TO BE
USED BY THE REVENUE OFFICERS OF THE
UNITED STATES, WITH GLASS HYDROMETERS,
INDICATING THE PER CENTS BY VOLUME OF
ALCOHOL IN SPIRITUOUS LIQUORS, FOR
DETERMINING THEIR RELATIVE VALUES**

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ALCOHOL IN SPIRITUOUS LIQUORS,
FOR
DETERMINING THEIR RELATIVE VALUES, &c.

CALCULATED BY
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UNDER THE SUPERINTENDENCE OF
PROF. A. D. BACHE.

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PREFACE.

THE following tables have been computed from data observed with the greatest skill and care; and the calculations were, in every instance, verified by causing them to be made at the same time independently by two persons. It is, therefore, believed that they are free from errors.

The work was undertaken by request of the Secretary of the Treasury, and has been executed by Prof. R. S. McCulloh, under the general direction and control of Prof. A. D. Bache, Superintendent of Weights, Measures, and Balances.

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Those who desire full information with reference either to the fundamental data upon which these tables are based, or to the methods employed in their calculation, may refer to Sen. Doc. No. 50, 1st Sess. 80th Cong. and to a supplementary report submitted with this manual to the Treasury Department.

EXPLANATION OF THE TABLES,
AND DIRECTIONS FOR THEIR USE.

TABLE I.

TRUE PER CENTS.

THIS table shows the *true per cent.* of alcohol by volume, or the number of gallons of pure alcohol in 100 gallons of spirit, for every indication of the hydrometer, and every degree of temperature from 20° to 100° of Fahrenheit's thermometer.

Provided, that the number of gallons, or the volumes, be measured at the standard temperature of 60° of Fahrenheit's thermometer.

Example.

Suppose a cask of spirits to have been gauged at the temperature of 60° Fahr., and

the liquor contained to have been found to be precisely 90 gallons at that temperature. Also, suppose a portion of the spirit, when tested with the hydrometer, at the temperature of 51° Fahr., to have given an indication of 48; then we find by the table 49.99 exactly, or 50 nearly, to be the corresponding true per cent. of alcohol; hence 44.99, or 45 gallons nearly, will be the quantity of alcohol upon which the value of the spirit depends and duty is to be levied.

Remark. As the operations of gauging are not to be depended upon for the measurement of quantities so small as hundredths of the gallon, the officers of the revenue should, in every instance, carry their calculations only to tenths of the gallon. Thus any quantity greater than 44.85, and less than 44.95, should be estimated at 44.90 only; and any quantity between 44.95 and 45.05 at 45.00.

TABLE II.

VOLUMES.

WHAT we have said above has been on the supposition that the gauging of spirits has been performed at the temperature of 60° Fahr.;— a condition which in practice cannot be realized, except in a very few accidental instances.

That an increase of heat causes liquids to expand in volume, and a decrease produces contraction, is a familiar truth. Hence the gauged quantity of the same liquor in a cask varies with its temperature, and it is necessary to refer all measurements to some assumed standard temperature, such as 60° Fahrenheit; or, in other words, to reduce the quantities measured at other degrees of temperature to what they would have been if measured at a given temperature. Table II. has been constructed for this purpose; it shows at once the *volume* which

1000 gallons of spirit, measured at any temperature from 20° to 100° Fahr., would become if brought to the temperature of 60° Fahr., the true per cent. or strength being known.

Example.

Suppose that a cask of rum is found by gauging to contain 100 gallons, the temperature of the liquor being 29° Fahr., and the observed indication of the hydrometer 60 per cent. Then, by Table I., we see that the *true per cent.* of this liquor is 67.60 ; and by Table II., that the 100 gallons at 29° Fahr. would expand to 101.44 gallons at 60° Fahr. Hence 101.44 multiplied by 67.6 per cent. gives ~~61.47~~ 67.56 gallons (or practically 61.5) as the quantity 67.6 of pure alcohol in the cask.

These calculations are simple, but to render their performance by the revenue officers unnecessary, as well as to prevent errors, they have been made and embodied in the following table of *Commercial Values*; which alone is to be used in levying duties.