NOTES ON THERMODYNAMICS, PART I

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Notes on Thermodynamics, Part I by H. W. Spangler

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Trieste

NOTES

ON

THERMODYNAMICS.

BY

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PART I.

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PREFACE.

FOR the purpose of covering the theoretical side of thermodynamics more rapidly than could be done with the aid of existing text-books, the author prepared these notes four years ago for use in his classes.

The results were fairly satisfactory, and as the work is now used by other teachers, a revised edition has been prepared. In this, errors have been corrected, the text has been condensed, and additional problems have been added.

It is not intended as a reference-book, except for those who have worked it through and have solved the problems.

There is little that is new in it. All the later writers have been consulted in preparing the work, and whatever has seemed the most satisfactory method of arriving at a result has been made use of.

The work is not complete in itself, and a good table of the properties of vapors is required to work out many of the problems. The tables prepared by Professor Peabody are used in the text.

H. W. SPANGLER.

UNIVERSITY OF PENNSYLVANIA,
June 6, 1901.

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NOTATION.

A = Heat equivalent of work = $\frac{1}{778}$.

c = Specific heat, the subscript indicating the law of the expansion, and is used whether units are foot-pounds or heat-units.

H = Heat required in heat-units or foot-pounds.

J = Mechanical equivalent of heat = 778.

K = Constant of equation $pv^n = K$.

λ = Total heat required to make 1 pound of vapor from liquid at 32 degrees F.

m = Weight.

M = Weight.

n = Exponent in equation $pv^n = K$.

p = Pressure in pounds per square foot, absolute.

q = Heat of liquid.

r = Total latent heat.

ρ = Inner latent heat.

R = Constant for any substance in equation $pv = RT$.

s = Volume of 1 pound of vapor.

σ = Volume of 1 pound of liquid.

t = Temperature Fahrenheit.

T = Temperature absolute.

u = Difference between the volume of 1 pound of vapor and 1 pound of liquid = $s - \sigma$.

v = Volume in cubic feet of 1 pound.

V = Any volume.

W = Work, foot-pounds or heat-units.

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NOTES ON THERMODYNAMICS.

In Physics a distinction is made between perfect gases and vapors. In this work we will also deal with these two classes of substances, and, for engineering purposes, perfect gases are such as practically obey the laws of Boyle and Charles. Under the head of perfect gases would be classed air, hydrogen, oxygen, superheated steam, ammonia, carbonic acid, etc., all being sufficiently far from their condensing-point to obey the laws referred to above.

In the shape of a formula these laws can be best stated as

$$pv = RT. \quad . \quad . \quad . \quad . \quad . \quad (1)$$

This equation is constantly being used in thermodynamics, and the exact meaning of the terms is important. In all this work English units, pounds, feet, and degrees Fahrenheit will be used. In these units the following definitions may be given to the terms of equation (1):

p is the absolute pressure in pounds per square foot.

v is the volume in cubic feet of 1 pound of the substance dealt with.