ing the hemp seed in bluestone solution will kill the rape seeds, but not the hemp. Water heated to 140° F. appears not to hurt hemp seeds, but the rape seeds are destroyed by this temperature. It is found that the rape seeds maintain their vitality for at least thirteen years in the soil. Professor Garman insists upon it that by the use of improved machinery the rape seeds may be largely removed from the hemp seed. The application of lime, salt, etc., to the soil is found to have no value.

THE STUDY OF GALLS.

SOME time ago a notice was made in these columns of a book of Edward Connold, of England, entitled 'British Vegetable Galls,' and the suggestion was made that in America this field of inquiry is practically uninvaded. We are glad to know that Professor M. T. Cook, of DePauw University, has been giving attention to these structures for some time. We have before us two bulletins issued by the Ohio State University devoted to 'Galls, and Insects Producing Them,' by Professor Cook. This article is a preliminary publication which promises a much more extended publication in the future. The article as at present published includes 'Morphology of Leaf Galls,' 'Apical Bud Galls,' 'Lateral Bud Galls,' 'Stem Galls' and 'Development of Galls.' It is the intention of Professor Cook to continue this work, enlarging the scope of his inquiries until he has material enough for an extended publication. We may, therefore, confidently expect an American volume comparable to Connold's British volume referred to above.

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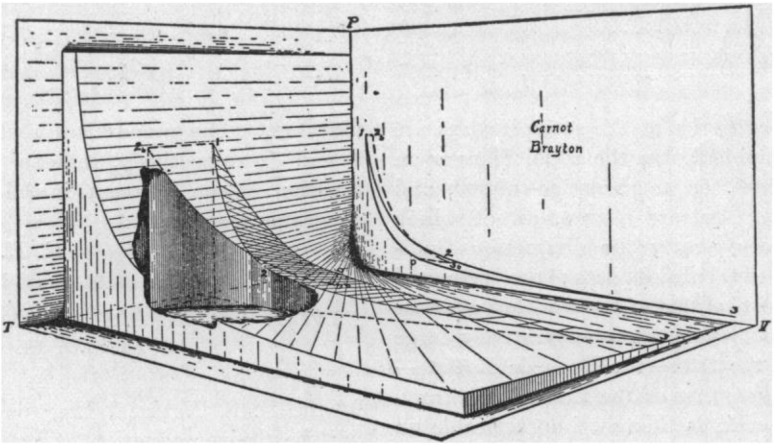
'GRAPHICS OF THERMODYNAMICS.'

MESSRS. BATES AND WELBORN, in the *Sibley Journal of Engineering*, present an interesting study of the relations of five gas-engine type-cycles and graphically exhibit their characteristics in three-dimension diagrams which strikingly illustrate the text.* A common compression line is assumed and the same amount of work is performed by each cycle; all performing similar work with similar heat-supply, under these conditions, as indicated by Röntgen's theorem.



Characteristics of Cycles.

All heat-engines employing a perfect gas as working substance, in a cycle composed of a pair of adiabatics crossed by a pair of isodia-

* *Sibley Journal of Mechanical Engineering*, June, 1903, p. 372. *Vide* 'Thermal Lines on Isometric Planes,' *Sibley Journal*, February, 1900, by R. H. T.; 'Graphic Diagrams and Glyptic Models,' *Jour. Franklin Inst.*, January, 1896, by R. H. T.

batics, have the efficiency $(T_1 - T_0)/T_1$, where T_1 and T_0 are the temperatures of the terminals of the compression line.

Adopting the methods of the writer, the following data are obtained.*

ordinates to pressure, volume and temperature planes. The two cycles are seen in usual form on the p-v plane and their respective diagrams are indicated throughout the figure by full lines for the Carnot, dotted lines for Brayton. The numerals 1 and 1_0, 2 and 2_0, 3 and 3_0, respectively, indicate the same distinction. The common initial point of the diagrams is seen at 0.

R. H. Thurston.

Characteristics of Type-Cycles.

	Absolute Pressure Lbs. per sq. in.				Absolute Temperature.			
	p_0	p_1	p_2	p_3	T_0	T_1	T_2	T_3
Carnot	15	115	23.8	3.11	520	931	931	520
Otto	15	115	188.3	24.5	520	931	1522.7	852
Brayton	15	115	115	15	520	931	1352.7	755
Ericsson	15	72.3	72.3	15	520	520	931	931
Stirling	15	72.3	133	27	520	520	931	931

	Volumes.				Maximum Pressure.	Maximum Temperature.	Maximum Volume.
	V_0	V_1	V_2	V_3			
Carnot	1	.2334	1.125	4.82	115	931	4.83
Otto	1	.2334	.233	1	188.3	1522.7	1.00
Brayton	1	.2334	.338	1.45	115	1352.7	1.45
Ericsson	1	.207	.372	1.79	73	931	1.00
Stirling	1	.207	.207	1	130	931	1.80

The characteristics of the several cycles are displayed graphically in the usual manner on pressure-volume, on temperature-volume, and on temperature-entropy planes, all of which bring out very clearly the distinctions indicated by the tabulated data; the principal being the great volume of the working cylinder for the Carnot cycle, the comparatively large pressures of the Otto—the Beau de Rochas—and the low pressures of the Ericsson diagram. The Carnot cycle is thought impracticable on account of engine volume, weight and cost; the Beau de Rochas involves very high temperatures and pressures and the Ericsson and Stirling engines seem likely to waste largely by dissipation of heat.

"The Brayton, on the whole, seems to promise best and, while practical obstacles modify any application, it yet remains true that recent reports would seem to place engines operating in this cycle in the lead."

The most novel and perhaps immediately interesting feature of the paper is its illustrations of the cycles discussed by forms in relief. The accompanying engraving is an illustration of one of these—a comparison of the Carnot and the Brayton cycles, referring co-

*Manual of the Steam-Engine,' Vol. I., p. 418.

EXHIBIT OF THE U. S. NATIONAL MUSEUM AT ST. LOUIS.

The most striking feature of the exhibit of the U. S. National Museum at St. Louis will be the reproduction of a full grown sulphur-bottom whale. The mold for this was obtained through the courtesy of the Cabot Steam Whaling Co. at their station at Balena, Newfoundland, and was made from one of the largest whales taken this summer; a skeleton of the same species was presented by the Colonial Manufacturing Co., of St. Johns, Newfoundland. As definite measures and weights of whales are not easily obtainable some details on these points may be of interest. The animal, a male, from which the skeleton was procured, measured 74 ft., 8 in. from the notch of the flukes to the tip of the nose, or 79 ft. from tip of flukes to tip of lower jaw. The girth around shoulders was 35 ft. and the width of the flukes 16 ft., 5 in. The skull, over all, measured 19 ft. and the width across