Algebraic theory of Thermostatics.

Repesh our memory of thermo "dy namics", as we never taught in 2 nd year university

Truesdell & Bh

Describe two all theories, and a certain morphism.

Shall refer back to a certain exact sequence. It A is a commutative ring and DV and Do are two commuting devivations of A. Then we can make the following construction

(A is a comm. (R-algebra).

This is a complex (compositions are zero), because the

What is A supposed to ripresent?

Variable quantities associated with some piece of substance.

In particular

Dy is pantial derivation wir to volume - temperatore

Among these quantities, there a countral ones:

In A there are two distinguished this I, it is A.

2: latent heat, is: specific heat.

2: latent heat in: specific heat (at constant volume)

Have also pEA, OEA (pressure, and temperature, resp)

is there something? This was Carnot's wrong assumption.

Think of (21,2) as a diff form. Is it [exact [?]

then is an E s.E.

 $E \longmapsto \langle \lambda - p, u \rangle$

It can be adjusted to be one;

Can have an interpating factor, namely of

 $S \longmapsto \langle \frac{2}{\sigma}, \frac{\varkappa}{\sigma} \rangle$

S= entropy.

2

Carnet: Q s.t. Q = 2v + x.o. (Q = heat content). (Q is meaninghi, Q is not). But there is E

(energy); E= 2 i + x o -pi

p is a mechanical quantity (macroscopic).

Since about is a complex, we get $\frac{\partial_{0}(\lambda-p)}{\partial_{0}(\frac{\lambda}{0})} = \frac{\partial_{v}(\mu)}{\partial_{v}(\frac{\lambda}{0})}$

Basic arrow of one of my theories.

Unany 11's Do Dr , nullany op's p, of

A model for tricker of theories is a possible substance

(at least FP models). There may be nilpotents

Thermostatics since the temperature is constant over the whole body.

What are these two theories (three, rather: there is a same Theory underlying both).

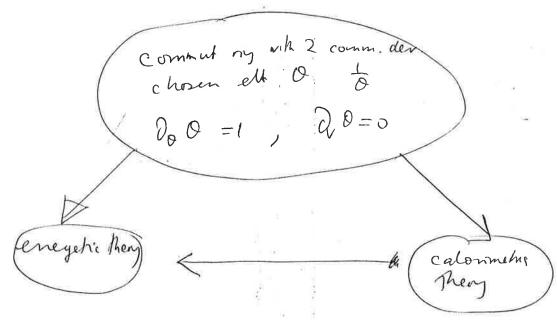
Commetation ring: with two commuting de whations with chosen ell. O invertible to and To 0 = 1 Ov 0 = 0

But v as a chosen elt. does not occur (it so happens)

This is the common theory. The two theories

The "energetic" theory and the "calorimetric" theory

and a morphism energia (alonimetric



Pepends on the substance, "constitutive relations".

Easiest way to present: one acrom

$$\partial_{\nu} \mathcal{H} = 0.00p$$

This is pres of caloninetic theory. Inother is

$$\begin{array}{c}
\partial_0 (\lambda - p) = \partial_v R \\
\partial_0 (\frac{\pi}{6}) = \partial_v (\frac{R}{6})
\end{array}$$

Assume Top exist. (always negative; pressure and volume are always inverse prop., not just be perfect gases)

Presentation of the other theory: specified nullary up's Si and E and ax ion

 $\mu \longmapsto \partial_{\Phi} E$. 2 --- 8. g. s $P \longmapsto \lambda = \lambda - \partial_{\nu} E$

A better presentation is by using if "Gibbsian her energy" (due to [Rietich]) $\psi = \partial_0 E = 0.005$ $P = \lambda - \partial_v E = /0 \partial_v S - \partial_v E = -\partial_v (E - 0.S)$ bearuse D. is zero

E- 0.5

is therefore the energy which is fee, to be used for mechanical work.

Theory her on y with no acroms.

Interpretation of the y theory 4 - E-0.5

Vice versa

 $\gamma_0 = 2$

in the exact sequence.

Duk = 0.02p

One example is the ideal gas Here, A = functions of v, O; $p \cdot v = R \cdot O$ K = ?(spearfies what bird of gas). Verity axioms of calorimetric theory

Conclude $\lambda = p$ $0 \cdot \partial_0 p = p$ i'e. i= u.o. : w DE = 0 so E is a function.

of O only:

In the same way, you had also DVH = 0 so it a hunchon of O only. (Here Carnot was wrong: I perfect gases where Jok = 0) Can also deduce --2nd example "photon gas" Stefan, Bolzmann Black body rakon, radiation happed in a cavity P = 1 E = function of O only. (Light exects pressure) (1/3 comes from 3-dimensionality of space). Again it is to be determined. We out $H = c \cdot V \cdot O^3$ c a constant $p = B \cdot O 4$ (led Planck to quantum mechanias). $\gamma = -a.v.04$ D .. Back to perfect gas ry = 0 + R.O. log (V) (Vo a Mesena volume) Calculate speed of sound if we understand adiabatic process Mohration: processes. O : why the dot.? What A process is a paper through the mil on which A functions. So edgebraically, a vity homomorphism A-B where B is another viry with one. derivation (1° operating ("B = functions of time"), satisfy $\dot{E} = \lambda \dot{v} + \dot{N} \dot{o} - p \dot{v}$ mon geneally [f'= dvf·i + dof·o] (chain rule); (This is a process which leaves the parameters fixed for every f in A. The parameters are not mentioned here: electric potential etc., chemical potential,...) "Q=0" Adiabatic process in which

re 20+40 =0.

Morphism of alg. Theories Leads to a left adjoint

 $Spec(\overline{A})$ Spec(A).

our parhub closed form is A becomes exact in A.

r

.

.

e:

X(***)

*

.

125 1

.

ž •