

RECIPROCIITY

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Published by NEW SCIENCE ADVOCATES, INC., an organization devoted to promoting the Reciprocal System of physical theory.

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Vol. X, No. 2

Spring-Summer, 1980

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PROSPECTS FOR NEW SCIENCE ADVOCACY

The Fifth Annual NSA Conference will be held in Huntsville, Alabama, August 22-23, 1980. (See p.4)

In relation to the coming Fifth Annual NSA Convention let's examine some current prospects for new science advocacy.

Begin with things. By things ordinarily is meant matter in its SOLID phase. Some people believe that the physical universe is composed ultimately of nothing else. This is a source of the fallacy of reification--that all is everything.

The hieroglyph for truth in the Chinese language apparently originated as a full solid bag (1). Professor Einstein believed that without solid bodies space could not exist and that without space, time too would be non-existent. According to his concept of space-time, the idea of space "seems to presuppose the concept of the solid body" (2). Then time too presupposes things, in Einstein's philosophy.

In any case the SOLID is an unequivocal kind of physical object, even if NOT the ONLY kind and even if the physical universe is NOT merely a universe of matter.

Can anything new be said about the SOLID or CRYSTAL? In particular, have the ACTUAL attractive and repulsive forces which cause the cohesion of atoms or molecules in SOLIDS been identified, distinguished and related?

A significant byproduct of the reciprocal system is that its fundamental postulates imply a theory of solid matter COHESION, quite superior to the prevailing theory. According to the latter, the cohesive forces altogether are essentially ELECTRICAL. (Like charges repel, unlike charges attract except that in the covalent bond like charges attract and in metals the metallic atoms have to be assumed without evidence ionized with electrons free to roam in bands through the interstices of the postulated nuclear cores.)

Advocates of the reciprocal system, who have been studying D. B. Larson's explanation of solid cohesion, published over 20 years ago, are accumulating conclusive evidence that solid cohesion is actually a NON-ELECTRICAL process. At Huntsville in August, 1980 evidence will be presented to show that the role of REPULSIVE FORCE in solid cohesion is played by the well-known gravitational motion, while that of ATTRACTIVE FORCE is played by a less known but within the reciprocal system theory well-established SPACE-TIME PROGRESSION FORCE.

Ronald W. Satz's discussion, THE EQUATION OF STATE OF SOLID MATTER, in this issue of RECIPROCITY is an excellent example of new work now in progress by NSA members to explain adequately the solid state of matter for the first time in human history.

Continue next with no things. No things are not necessarily nothing. Among physical objects are other than things and even the opposites of things. These constitute physical nothings.

It is true that some alleged nothings don't exist, while others do. Non-existent nothings probably include phlogiston, void, aether, plenum, time separated from space, quarks, gravitons, nuclear atoms, neutron stars, black holes, etc. Existing nothings include motion, space-time progression, light, fluids (fluid matter), "anti-matter" (cosmic matter), etc.

In the perspective of the reciprocal system of physics: For every physical object that exists, its MULTIPLICATIVE INVERSE also necessarily exists within the physical universe. For instance, if the chemical elements listed in the Periodic Table exist, then so must and do exist also their INVERSES, the cosmic elements. More than 20 years ago D. B. Larson began identifying several isotopes of some of the cosmic elements. This work continues. New cosmic element isotopes have been discovered. A review of this work in progress has been reported in the JOURNAL OF THE MINNESOTA ACADEMY OF SCIENCE 45, No. 3, 1979 by R. W. Satz and F. H. Meyer. With the consent of the Editor, JMAS, it is reprinted in this issue of RECIPROCITY.

In the light of the reciprocal system of physics the prospects for new science advocacy have become virtually unlimited. Numerous myths of modern physics remain to be exposed; they now can be held up to the light for close examination. Two of these will be cited for the purpose of illustrating our claim. They are the myth of solar fusion and the myth of the nuclear atom.

The previous issue of RECIPROCITY, Vol. X, No. 1, page 2 contained an interesting letter composed by the since deceased Editor of the Science Fiction-Science Fact magazine, ANALOG, John W. Campbell. Editor Campbell 11 years ago hurled this challenge to all would-be new science advocates:

"Come up with a new theory of atomic structure which permits you to produce hydrogen fusion to helium, or annihilation of matter to pure energy, and the old theory will collapse."

The reciprocal system theory of atomic structure is a more than 20 years enduring new theory which shows how the sun and stars generate radiant energy by the radi active destruction of matter--fission of their heavy elements. The reciprocal theor does not allow the sun and stars to generate the bulk of their radiant energy by the fusion of four hydrogen nuclei to a helium nucleus. Eleven years ago John Campbell would have been nonplussed to learn that in 1980 solar fusion with neutrino formation remains a theory unfounded on the experiment specifically designed to confirm it. Physicists and scientists generally do not need a theory of atomic structure to explain what evidently does not happen in the sun and stars.

If solar fusion is a myth, then how free of myth is the physics which led to the theory of solar fusion? The conjecture about solar fusion is entirely constructed from nuclear physics, which is predicated on the Rutherford-Bohr model of the atom of matter.

The principal reason why the nuclear atom model has remained completely in command of physical and chemical research, apart from the question of its truth, is that it has seemed to work. It works elegantly to explain solar fusion, a POSSIBLE way the sun generates its radiant energy that has not yet been shown to be the ACTUAL way.

It is no wonder that belatedly questioning of the nuclear atom model and solar energy has been under way (3, 4). Furthermore, the splendid logical examination of the facts about atomic structure in the light of D. B. Larson's reciprocal system of physics (5) discloses that the nuclear atom model is, in fact, itself a myth.

REFERENCES

1. Needham, J. History of Science and Civilization in China.
2. Einstein, A. Ideas and Opinions. Laurel Edition, p. 271.
3. du Nouy, Lecomte. The Road to Reason. Longmans, Green and Co., 1949.
4. Shrader-Frechette, K. Philosophy of Science 44, No. 3, September, 1977.
5. Larson, J. D. The Case Against the Nuclear Atom. North Pacific Publishers, 1963. Portland, Oregon.

DAVID HALPRIN CORRESPONDENCE

NSA MEMBERS AND FRIENDS: In preparing for our 1980 Fifth Annual Conference you should attend particularly to David Halprin's Letters in this issue. They are a good summary of some unfinished business of suggestion and criticism from our previous Conferences. David is more than a corresponding NSA member from Victoria, Australia. As he attended the Fourth 1979 NSA Conference in Superior, Wisconsin, he plans to attend the Fifth NSA Conference in August, 1980 at Huntsville, Alabama. David Halprin is a charter member of NSA, a pharmacist in Australia and among the most perceptive thinkers and supporters of the reciprocal system of physics in our ranks.

FIFTH ANNUAL NSA CONFERENCE PREPARATION

NEW SCIENCE ADVOCATES, INC., a non-profit corporation, organized to promote the reciprocal system of physics, will hold its Fifth Annual Conference on the Huntsville campus of the University of Alabama, Friday-Saturday, August 22-23, 1980, in the University Science Building, Room 127.

Huntsville is the site of the Marshall Space Flight Center, an appropriate place for meeting to discuss the high-flying but also down-to-earth ideas, inherent and unalienable, in the theory of the new reciprocal system of physics.

Purpose of the Huntsville Conference is to reexamine and develop organization of the NSA corporation and its organ, RECIPROCITY, and to accelerate the dissemination of new knowledge of physics obtained through innovative and critical application of the unified theory of the reciprocal system.

Huntsville Conference Program Notes

NSA Round Table discussion will be held 9:00 A.M. - 10:30 A.M. Friday morning, August 22, the University Science Building, Room 127. Hans Wuenscher, host of the Huntsville Conference presiding. The Round Table will be brainstorming our best ideas to explain and promote the reciprocal system. The Round Table will be a Think Tank in action to improve our understanding of the reciprocal system. See David Halprin's correspondence in this issue.

Presentation of contributed papers will begin at 10:30 A.M. and continue to noon Friday morning.

After lunch at 1:00 P.M. Dewey B. Larson will present an invited informal discussion, INTRODUCTION TO THE RECIPROCAL SYSTEM. Participation by the assembly of all present will be welcome.

For the rest of Friday afternoon to 5:00 P.M. time is reserved for additional contributed papers. As a rule, presentation may be limited to 15 minutes per paper with 5 additional minutes for questions to author.

Time and space have been reserved for NSA members and guests to tour the exhibit halls of the Marshall Space Flight Center Friday evening after early dinner.

If you intend to contribute a paper to the Friday program, please notify Dr. Rainer Huck, Program Committee Chairman, and Secretary Ronald Satz, if you have not already done so, about the title and an abstract of your paper and any A-V aids you may need by August 11. Addresses of Huck and Satz are found on the masthead of this RECIPROCITY.

Saturday morning, August 23, presentation of more contributed papers will begin at 9:00 A.M. and continue until each one has had a chance to have his or her say about any question or issue related to the reciprocal system.

Saturday afternoon a meeting of NSA members who are in Huntsville will take place (time to be announced later) to elect NSA officers and candidates to open positions on the Board of Trustees for the 1980-81 period.

Our host, NSA member, Hans Wuenscher, informs us that no low cost dormitory housing is available on the University campus at Huntsville. If you come via

automobile or by airline, go to the Carriage Inn, 3811 University Drive NW, Huntsville, AL 35805, (205) 337-5555. Our host, Hans Wuenscher, has reserved a block of room accommodations with the Carriage Inn management at now best available guaranteed prices. Airline Connections: Huntsville/AL is served by Eastern, United and Republic with direct flights from Atlanta, Denver, Washington, Memphis, Minneapolis and Chicago. There is free limousine-service from the airport to the hotel. Call Carriage Inn on special telephone from airport. Convention Hotel/Motel is: Carriage Inn (SEE DETAILS ABOVE).

Room reservations should be made directly by each party not later than August 8. Special rates for the NSA Conference are: \$33-per twin double (2 double beds) and \$28-per single (one double bed).

MEETING SITE: Science Building, Room 127, University of Alabama-Huntsville.

MEETING PROGRAM:

- Thursday, August 21. 8:00 P.M. Board of Directors Meeting (at Carriage Inn)
- Friday, August 22. 9:00 A.M. Round Table Panel Discussion
- 10:30 A.M. Paper Presentation Session
- 1:30 P.M. Introduction to Basic Reciprocal Theory.
D. B. Larson.
- 5:30 P.M. Dinner, Carriage Inn "Camelia Room," with
a Short Keynote by president, Dr. Anderson.
- 7:00 P.M. Alabama Space and Rocket Center. Tour at
Tranquility Base, the largest and most complete
space exhibition of actual lunar mission hardware.
- Saturday, August 23. 9:00 A.M. Paper Presentation. If time permits,
Informal Discussions.
- 1:30 P.M. General Business Meeting, President Frank
Anderson presiding.

REGISTRATION:

Please give notice about your participation to: Hans F. Wuencher, 2004 Dogwood Lane, Huntsville, AL 35810, (205) 546-7975 not later than August 1. The banquet dinner will cost \$10.00. The Rocket Center fee is \$3.00. We must know in advance how many dinners to order; therefore, please remember to tell Hans as promptly as you can.

CALL FOR PAPERS:

If you plan to contribute a paper, discussing some issue or question about the reciprocal system, please make sure to send title and abstract to Program Committee members, Rainer Huck and Ronald Satz.

NOTE:

After July 1 Frank H. Meyer's summer address will be 1103 15th Ave. S.E., Minneapolis, MN 55414; (612) 331-6086.

THE EQUATION OF STATE OF SOLID MATTER

by
 Ronald W. Satz

For many years scientists and engineers have had available an excellent equation of state for gaseous matter. Now, at last, the Reciprocal System of Dewey B. Larson is able to give us an exact equation of state for solid matter. This paper will present a unified treatment of the subject, with Reference 1 as the starting point.

I. Volume of Solid as a Function of Temperature with Pressure Constant

From the material presented in Chapter 8 of Ref. 1, I have drawn a generalized plot of thermal expansion coefficient versus temperature, Figure 1. The symbols are defined as follows:

- α = thermal expansion coefficient
- T = temperature
- T_M = temperature of solid end point (at or close to melting point)
- V_M = volume at solid end point
- T_1 = first transition temperature
- α_0 = initial value of thermal expansion coefficient at absolute zero temperature
- V_0 = initial volume at absolute zero temperature
- V_1 = volume at transition temperature
- α_0' = initial value of thermal expansion coefficient based on second segment of curve
- V_0' = initial volume based on second segment of curve

With the initial volume of the first segment of the curve included, eq. (8-4) of Ref. 1 becomes

$$V = V_0 + \frac{K}{n^3} T^2 \quad (1)$$

where K is a constant and n is the number of rotational units that are themally vibrating. This equation can be put into a more usable form involving T , T_1 , α_1 , and α_0 --all of which can be determined from theory. The thermal coefficient of expansion at temperature T is

$$\begin{aligned} \alpha &= \frac{1}{V} \frac{dV}{dT} = \alpha_0 \\ &= \frac{2KT}{n^3} \left[\frac{1}{V_0 + \frac{KT^2}{n^3}} \right] + \alpha_0 \quad (2) \\ &= \frac{2KT}{n^3 V_0 + KT^2} + \alpha_0 \end{aligned}$$

$$\text{At } T_1, \quad \beta_1 = \frac{2KT_1}{n^3V_0 + KT_1^2} + \beta_0$$

$$\text{Then,} \quad \frac{\beta_1 - \beta_0}{2T_1} = \frac{K}{n^3V_0 + KT_1^2}$$

$$\text{So,} \quad \frac{2T_1}{\beta_1 - \beta_0} = \frac{n^3V_0}{K} + T_1^2$$

$$\frac{K}{n^3} = \frac{V_0}{\frac{2T_1}{\beta_1 - \beta_0} - T_1^2} \quad (3)$$

$$\text{Therefore,} \quad V = V_0 + \frac{V_0 T^2}{\frac{2T_1}{\beta_1 - \beta_0} - T_1^2} \quad (4)$$

This equation holds from $T = 0$ to $T = T_1$. Larson has deduced the following values of β_1 , β_0 , and T_1 :

$$\begin{aligned} \beta_1 &= 5.17 \times 10^{-6}/^\circ\text{K} \text{ for one unit} \\ &= 10.3 \times 10^{-6}/^\circ\text{K} \text{ for two units} \\ &= 15.5 \times 10^{-6}/^\circ\text{K} \text{ for three units} \\ &= 20.7 \times 10^{-6}/^\circ\text{K} \text{ for four units} \end{aligned}$$

$$n \text{ units} = [3576/T_M]$$

$$\begin{aligned} \beta_0 &= -2/7 \times \beta_1 \text{ for electropositive elements} \\ &= -1/7 \times \beta_1 \text{ for some electronegative elements} \end{aligned}$$

$$T_1 = 3.98 (a + z + y)^\circ\text{K}$$

a, z, y are from Table 22 of Ref. 1

Thus given the volume of the solid at zero temperature, the rotational factors of the element, and the solid end point temperature, the volume V at any other temperature (up to T_1) can be easily determined.

The equation for the volume for temperatures above T_1 has the same form as eq. (4):

$$V = V_0 + \frac{V_0 T^2}{\frac{2T_1}{\beta_1 - \beta_0} - T_1^2} \quad (5)$$

For this equation to be of use, V_0' and ρ' must be expressed in terms of known quantities such as V_M and T_M . Now,

$$V_M = V_0' + \frac{V_0' T_M^2}{\frac{2T_1}{\beta_1 - \beta_0} - T_1^2}$$

$$V_1 = V_0' + \frac{V_0' T_1^2}{\frac{2T_1}{\beta_1 - \beta_0} - T_1^2}$$

In the equation for V_1 , solve for V_0' and put in equation for V_M :

$$V_M = \frac{V_1}{1 + \frac{T_1^2}{\frac{2T_1}{\beta_1 - \beta_0} - T_1^2}} \left(1 + \frac{T_M^2}{\frac{2T_1}{\beta_1 - \beta_0} - T_1^2} \right)$$

Or,

$$\frac{V_M}{V_1} = \frac{1 + \frac{T_M^2}{\frac{2T_1}{\beta_1 - \beta_0} - T_1^2}}{1 + \frac{T_1^2}{\frac{2T_1}{\beta_1 - \beta_0} - T_1^2}}$$

Let

$$C_2 = \frac{1}{\frac{2T_1}{\beta_1 - \beta_0} - T_1^2} \quad (6)$$

Then,

$$\frac{V_M}{V_1} = \frac{1 + C_2 T_M^2}{1 + C_2 T_1^2}$$

Solve for C_2 :

$$C_2 = \frac{V_M - V_1}{V_1 T_M^2 - V_M T_1^2} \quad (7)$$

From eqs. (6) and (7), β_0' , can be found:

$$\beta_0' = \beta_1 - \frac{2T_1}{\frac{V_1 T_M^2 - V_M T_1^2}{V_M - V_1} + T_1^2} \quad (8)$$

This value of β_0' can then be substituted into the equation for V_0' :

$$V_0' = \frac{V_1}{1 + \frac{T_1^2}{\frac{2T_1}{\beta_1 - \beta_0'} - T_1^2}} \quad (9)$$

With β_0' and V_0' known, eq. (5) is ready for use. Larson has deduced the following values of T_M and V_M :

$$\begin{aligned} T_M &= 1.80 * T_1 \text{ for one rot. unit vibrating} \\ &= 4.56 * T_1 \text{ for two rot. units} \\ &= 9.32 * T_1 \text{ for three rot. units} \\ &= 17.87 * T_1 \text{ for four rot. units} \\ V_M &= 1.0625 V_0 \frac{G_M}{G_0} \end{aligned}$$

where G_0 is the initial crystal geometric constant and G_M is the final one (some solids change crystalline structure as they expand).

The ratio V_M/V_1 can be generalized to any pair of final to initial volumes:

$$\frac{V_f}{V_i} = \frac{1 + C_2 T_f^2}{1 + C_2 T_i^2} \quad (10)$$

Compare this with the equation for a gas:

$$\frac{V_f}{V_i} = \frac{T_f}{T_i} \quad (11)$$

II. Volume of Solid as a Function of Pressure with Temperature Constant

The compression of a solid by hydrostatic pressure is discontinuous at certain pressures, here denoted as p_1, p_2, p_3, p_4 , etc. At these pressures, the internal pressure P_0 can change to $P_{01}, P_{02}, P_{03}, P_{04}$, etc., thus altering the slope of the compression curve. Larson has shown that between the transitions, the volume varies as the inverse square root of the pressure. The most general way to express this is with the following equation:

$$\frac{V}{V_{ref}} = \frac{P_0 + P_{ref}}{P_0 - P} \quad (12)$$

For the given value of P , the values of P_{ref} , V_{ref} , and P_0 must be determined by theory (or empirically if necessary) before V can be found. For a four transition solid we have the following:

$$\begin{array}{llll}
 0 < P < P_1 & V_{ref} = V_0 & P_{ref} = 0 & P_0 = P_0 \\
 P_1 < P < P_2 & V_{ref} = V_1 & P_{ref} = P_1 & P_0 = P_{01} \\
 P_2 < P < P_3 & V_{ref} = V_2 & P_{ref} = P_2 & P_0 = P_{02} \\
 P_3 < P < P_4 & V_{ref} = V_3 & P_{ref} = P_3 & P_0 = P_{03}
 \end{array}$$

Now, in the MKS system,

$$P_0 = 4.177 \times 10^{-23} \frac{aZy}{s_0^3} \frac{KN}{m^2} \quad (13)$$

where a , Z , y are the rotational compression values (similar to the thermal values) and s_0 is the base interatomic spacing. At each transition a , Z , y can change (and possibly s_0), thus causing P_0 to change.

Before continuing the discussion of the equation of state I will discuss some subsidiary properties of matter: the bulk modulus, the modulus of elasticity, and Poisson's ratio. Larson has derived the equation for compressibility; the solid bulk modulus is the inverse of this:

$$B = 2 * P_0 \quad (14)$$

(at zero external pressure and zero temperature for a pure substance). I will not derive the equation for the modulus of elasticity, E . In eq. (13) let the constants of the equation be written as J and generalize s_0 (for the moment) to s . Then the initial internal stress is

$$\sigma = -P = -Js^{-3} \quad (15)$$

By definition,

$$E = \frac{d\sigma}{d\varepsilon}$$

and,

$$\frac{d\sigma}{d\varepsilon} = \frac{d\sigma}{ds} \frac{ds}{d\varepsilon}$$

where ε is the strain:

$$\varepsilon = \frac{s - s_0}{s_0}$$

$$s = s_0 \varepsilon + s_0$$

$$\text{thus, } \frac{ds}{d\varepsilon} = s_0$$

Since $\frac{d\sigma}{ds} = 3Js^{-4}$

then $\frac{d\sigma}{d\varepsilon} = 3Js^{-4} s_0$

and when $s = s_0$ and $T = 0$ °K for a pure substance,

$$\frac{d\sigma}{d\varepsilon} \bigg|_{s_0, T=0} = 3Js_0^{-3} = -3P_0$$

$$E = -3P_0 \quad (16)$$

(stress and pressure are in opposite directions)

Poisson's ratio can be determined from the well-known equation

$$\nu = .5 - \frac{E}{6B} \quad (17)$$

Thus at zero temperature and pressure for a pure substance,

$$\nu = .5 - \frac{3P_0}{6 \cdot 2P_0} = .25 \quad (18)$$

This is in the "ball park" for most solids; however, most substances used in construction are impure and at other than zero temperature and, in addition, may contain a proportion of liquid molecules--thus drastically changing the values of Poisson's ratio and the modulus of elasticity. These considerations will be left to another paper.

Going back to eq. (12) we can generalize to the ratio of final to initial volume within a segment:

$$\frac{V_f}{V_i} = \frac{P_0 + P_i}{P_0 + P_f} \quad (19)$$

This compares with the equation for a gas:

$$\frac{V_f}{V_i} = \frac{P_i}{P_f} \quad (20)$$

III. Volume of Solid as a Function of Both Temperature and Pressure

The solid can be considered to undergo a pressure change at zero temperature and then a temperature change from the new volume. Let $P < p_1$. Then

$$V_{0,NEW} = V_0 \frac{P_0}{P_0 + P}$$

Let $T \leq T_1$. Then,

$$V = V_{0\text{NEW}} + \frac{V_{0\text{NEW}} T^2}{\frac{2T_{1\text{NEW}}}{\beta_1 - \beta_0} - T_{1\text{NEW}}^2} \quad (21)$$

The value of T_1 is not the same as before. To get to the original value of V_1 the new value of T_1 must be higher:

$$T_{1\text{NEW}} = \frac{2}{\frac{\beta_1 - \beta_0}{V_1} + \beta_1 - \beta_0} \sqrt{\frac{P_0}{P_0 + P}} \quad (22)$$

where V_1 is calculated from the original T_1 . I am assuming here that β_1 is as before.

If $P < p_1$ and $T \geq T_1$, then the value of V_0' has to be modified, since T_1 and T_M are different. I assume that β_0' is the same. Then the second term on the right in eq. (8) is the same and the new value of T_M can be found:

$$T_{M\text{NEW}} = \sqrt{\left\{ \frac{T_{1\text{NEW}}}{T_1} \left[\frac{V_1 T_M^2 - V_M T_1^2}{V_M - V_1} + T_1^2 \right] - T_{1\text{NEW}}^2 \right\} \frac{(V_M - V_1)}{V_1} + \frac{V_M}{V_1} T_{1\text{NEW}}^2} \quad (23)$$

Eq. (5) becomes

$$V = V_{0\text{NEW}}' + \frac{V_{0\text{NEW}}' T^2}{\frac{2T_{1\text{NEW}}}{\beta_1 - \beta_0} - T_{1\text{NEW}}^2} \quad (24)$$

Equations (21) and (24) (combined) represent the complete equation of the solid state.

IV. Example Calculations

As an example, consider one volume unit of silver at zero degrees K and zero external pressure. What is the volume at temperature T and pressure P?

First the thermal rotational factors, a-Z-y, from Table 22 of Ref. 1 are found; they are 4-3-1. With these, the temperature of the first transition point, T_1 , can be calculated:

$$T_1 = 8.98 (a+Z+y) = 8.98 (8) = 71.84^\circ\text{K}$$

Silver has a maximum of four magnetic rotational units vibrating, so the solid endpoint is

$$T_M = 17.87 * T_1 = 17.87 * 71.84 = 1283.78^\circ\text{K}$$

In this case the endpoint appears to be somewhat higher than the empirical melting point, 1234 °K. Thus it would seem that the thermal factors at the end point are lowered by one to 3-3-1, so that

$$T_M = 17.87 * 8.98 (3+3+1) = 1123.31^\circ\text{K}$$

Now the number of units to use in selecting s_1 is

$$\left[\left[\frac{3576}{1123.31} \right] \right] = 3$$

and therefore

$$s_1 = 15.5 * 10^{-6} / ^\circ\text{K}$$

Since silver is electronegative,

$$s_0 = -\frac{1}{7} s_1 = \frac{1}{7} * 15.5 * 10^{-6} = -2.214 * 10^{-6}$$

Then from eq. (4), $\frac{V}{V_0} = 1 + \frac{2 * T^2}{(15.5 + 2.214) * 10^{-6}} - 71.84^2$

$$\frac{V}{V_0} = 1 + 1.234 * 10^{-7} T^2 \quad T \leq T_1, P = 0$$

This equation holds good up to $T = T_1$ at which point

$$\frac{V_1}{V_0} = 1 + 1.234 * 10^{-7} T_1^2 = 1.0006369$$

For temperatures above T_1 , the values of V_0' and β_0' are needed. To calculate β_0' I am going to use the empirical value of T_M pending theoretical clarification. From eqs. (8) and (9),

$$\beta_0' = 15.5 * 10^{-6} - \frac{2 * 71.84}{\frac{1.0006369 * 1234^2 - 1.0625 * 71.84^2}{1.0625 - 1.0006369} + 7184^2}$$

$$= 9.647 * 10^{-6}$$

$$V_0' = \frac{1.0006369}{1 + \frac{71.84^2}{\frac{2 * 71.84}{(15.5 - 9.647) * 10^{-6}} - 71.84^2}} = 1.0004265$$

Thus from eq. (5),

$$V = 1.0004265 + \frac{1.0004265 T^2}{\frac{2 * 7184}{(15.5 - 9.647) * 10^{-6}} - 71.84^2}$$

$$V = 1.0004265 + 4.07623 * 10^{-8} T^2 \quad T > T_1, P = 0, V_0 = 1$$

(Note: no crystal change from FCC is assumed here).

Now we'll go on to look at the pressure relations. Assume that P is less than the first transition pressure p_1 (which is approx. 10^7 KN/m²) so that the initial compressibility factors from Table 14 of Ref. 1 can be used: a-Z-y = 4-8-1. From Table 4 of Ref. 1, $s_0 = 2.87 * 10^{-10}$ m. Then from eq. (13),

$$P_0 = 4.177 * 10^{-23} (4 * 8 * 1) / (2.87 * 10^{-10})^3$$

$$= 5.654 * 10^7 \frac{\text{KN}}{\text{m}^2}$$

Since $P < p_1$, $P_{\text{ref}} = 0$, and $V_{\text{ref}} = V_0$. Then eq. (12) is

$$\frac{V}{V_0} = \sqrt{\frac{5.654 * 10^7}{5.654 * 10^7 + P}} \quad \begin{matrix} P < 1.0 * 10^7 \text{ KN/m}^2 \\ T = 0 \end{matrix}$$

If $P = .001 P_0$,

$$\frac{V}{V_0} = \sqrt{\frac{P_0}{1.001 P_0}} = .999500$$

The bulk modulus B, modulus of elasticity E, and Poisson's ratio can now be calculated for a pure sample of silver at zero temperature:

$$B = 2 * P_0 = 2 * 5.654 * 10^7 = 1.1308 * 10^8 \frac{\text{KN}}{\text{m}^2}$$

$$E = 13 * P_0 = 3 * 5.654 * 10^7 = 1.6962 * 10^8 \frac{\text{KN}}{\text{m}^2}$$

$$V = .25$$

For the combined pressure and temperature loading, eq. (21) yields

$$V = V_0 \frac{5.654 * 10^7}{5.654 * 10^7 + P} + \frac{V_0 \frac{5.654 * 10^7}{5.654 * 10^7 + P} T^2}{\frac{2 T_1}{(15.5 + 2.214) * 10^{-6}} - T_1^2}$$

The value of T_1 to be used here comes from eq. (22):

$$T_1 = \frac{2}{\frac{15.5 * 10^{-6} + 2.214 * 10^{-6}}{1.0006369} + (15.5 + 2.214) * 10^{-6}}$$

If $P = .001 P_0$, then $\frac{5.654 * 10^7 T - 1}{5.65 * 10^7 / P}$

$$T_1 = 128.24 \text{ } ^\circ\text{K}$$

Putting this value of T_1 into the above gives:

$$\frac{V}{V_0} = .99950 + 6.91095 * 10^{-8} T^2 \quad \begin{array}{l} T < T_1 \\ P = .001 P_0 \end{array}$$

The new value of T_1 gives the new value of V_0' :

$$V_0' = \frac{1.0006369}{1 + \frac{128.24}{\frac{2 * 128.24}{(15.5 - 9.647) * 10^{-6}} - 128.24}} = 1.0002614$$

Thus, for temperatures above T_1 ,

$$V = 1.0002614 + \frac{1.0002614 T^2}{\frac{2 * 128.24}{(15.5 - 9.647) * 10^{-6}} - 128.24^2}$$

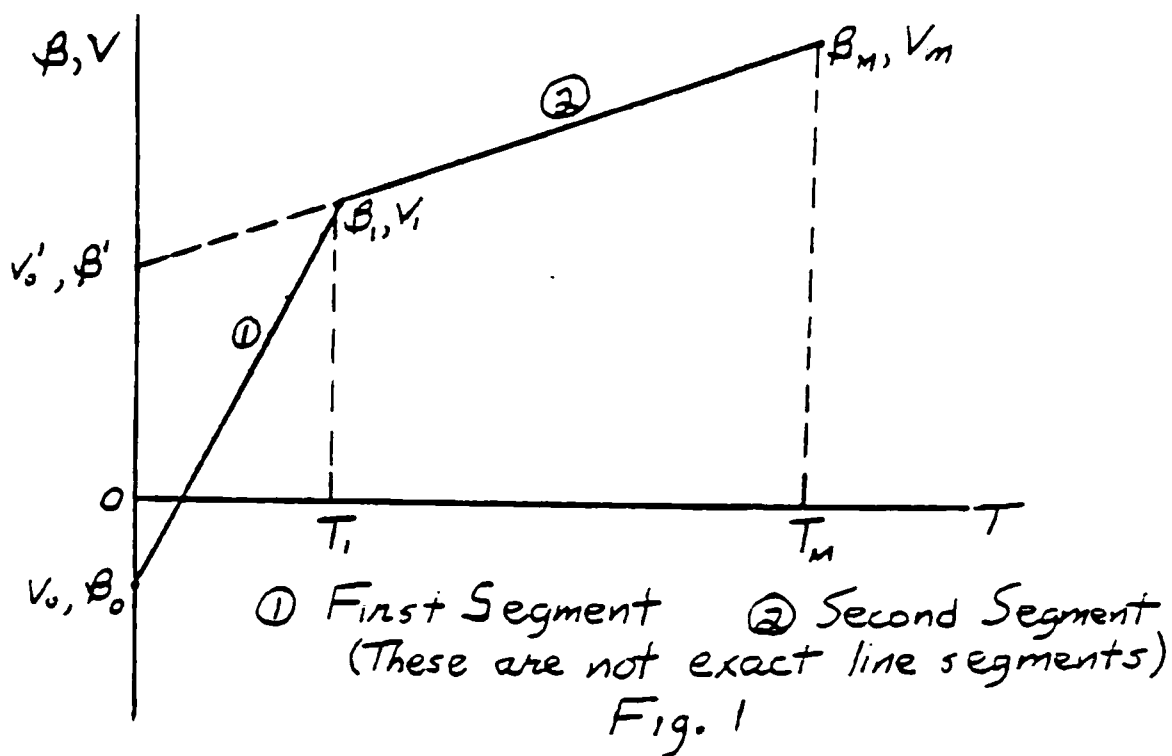
$$V = 1.0002614 + 2.28350 * 10^{-8} T^2 \quad \begin{array}{l} T > T_1, P = .001 P_0 \\ V_0 = 1 \end{array}$$

Finally, from eq. (23) I find that the new melting temperature is:

$$T_{M_{NEW}} = 1650.88 \text{ } ^\circ\text{K}$$

(I have assumed, however, that this does not affect the original value of β_1).

Basically the same procedure could be used with other elements, alloys, and compounds. Corresponding equations do not exist in quantum mechanics. A solution in "principle only" is not a true solution. A true solution is based on principle and works in practice.



Reference

1. Dewey B. Larson, Solid Matter, prepublication version of second volume of the revised edition of The Structure of the Physical Universe (Portland, Oregon: North Pacific Publishers, 1980).

Some Thoughts And Ideas From Down Under

David Halprin

How a lay person realizes integrated notions, Dimensions Abstract, Voids Imaginary, Devious Logic *etc.*.

This is an analysis of the thoughts that crossed my mind, when confronting the new paradigm, "*Reciprocal Theory*".

The only types of motion possible in the observable, (material or subjective), universe are rotational and/or translational, neither of which, separately or conjointly, can exceed the speed of light, 'c'.

For the purposes of completeness, for the description of the entire physical universe, (*i.e.* the mathematical model, on which *Reciprocal Theory* is based), then, and only then, must we consider as essential the 'existence' of the 'cosmic sector', together with the material sector, (the observable sector), hence the two sectors together represent the 'whole', *i.e.* the 'objective universe'.

There is a lower limit of precis, (or condensation), to which we can subject the entire concept of R.T. without losing clarity of meaning, so let us look at the 'postulates' as a NECESSARY, but not SUFFICIENT explanation of the overall 'concept', therefore an expanded form, that I now suggest, may help all others to 'come to grips' with the 'concept', the very NUB.

Ambiguities Must be Removed

e.g. "Ordinary Mathematics":

There is nothing wrong with non-Euclidean geometry *per se*, even though, surely, it can be classified within the concept of 'ordinary mathematics'. We merely wish to lay emphasis on SCALAR progression, as a concept, heretofore not defined, and then incorporate that into the postulate, with italicized 'scalar progression'.

The elegant and informative paper, on particle bombardment of gold, (by Ronald Satz), is very commendable, but let us observe the high level of differential calculus necessary, to the solution of such a D.E., namely Romberg's Method of numerical approximation. Yet, to a First Year Level University mathematics student, this may be too high-fallutin, too high a level for his understanding

to be considered as 'ordinary mathematics'.

("Easy for you, difficult for me" to quote señor Wences).

It would be described more aptly as 'specialized high-level mathematics.' So 'ordinary' is a RELATIVE term, rather than ABSOLUTE. Let us try to formulate the 'Theory of Absolutivity', if we must, by having all terms clearly defined, and of course, this eliminates succinct short postulates, EXCEPT as a first approximation, or guide, to the R.T. concept, as a whole.

Also the solution of the quartic equation in Ronald Satz's paper is hardly 'ordinary', except to higher mathematicians.

Also, Probability, is a highly specialized theory, with three different types of distribution curve to choose from. Which one to apply in a new field, such as R.T. depends on a complete understanding of Probability Theory; another high-level of mathematics, ordinary to some, extraordinary to others.

We are not gathered here solely for our own gratification. We are also out to proselytize, and this needs to be as carefully planned and formulated as a political campaign for Presidency, with, perhaps, more at stake. Years of planning could be necessary, and above all, we must NOT, by word or action, create a doubt in the mind of the listener or reader. We must never give the wrong impression about the 'concept', *i.e.* we must have non-ambiguous statements for a starter. Also no suggestions of a Theosophical* and/or cult nature must appear.

*(An early issue of Reciprocity talked of "beyond time and space". Is this not "thin ice" and pointless to bring up?)

Just as a deity is left out of traditional science, (except perhaps for Einstein's famous quote about God not playing dice), we must avoid it as a primary requisite for success, otherwise we sink into the mire of a 'flat earth'.