This analysis of the changes in the macro-economic system brings dynamic economics into a line with the analysis of the motion of a system of particles, *viz*., motion of the centre of gravity and motion about the centre of gravity.

An elaboration of the theory, with illustrations from Indian economic data will soon follow.

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ON THE COOLING CORRECTION IN CALORIMETRY

AN idea of the relative contributions of radiation and convection to the heat losses or gains in the laboratory experiments on calorimetry (in which a copper calorimeter is hung inside a bigger copper vessel by means of threads) can be obtained in the following way. For small differences of temperature, the rate of heat loss (which includes radiation and convection) is given by Newton's Law of Cooling. Expressed in symbols, this law is:

$$\frac{dQ}{dt} = K\ (\theta-\theta_0),$$

where 'dQ' is the amount of heat lost in the interval 'dt', 'k' a constant depending upon the nature and extent of the cooling body, the nature and pressure of surrounding gas, the shape, size and nature of any other vessel which surrounds the cooling body. θ & θ_0 are the temperatures of the body & surrounding medium respectively. If 'm' is the mass of the cooling body, 's' its sp. heat, and '$\delta\theta$' the fall in temperature in interval 'δt' in which it has lost heat by an amount 'dQ'

$$dQ = -\ ms\ \delta\theta$$
$$= K\ (\theta-\theta_0)\ \delta t \qquad (1)$$

$$\text{or } -\frac{\delta\theta}{\delta t}\cdot\frac{ms}{(\theta-\theta_0)} = K \qquad (2)$$

Thus if 'k' is calculated by inserting the value of the rate of fall of temperature $-\frac{\delta\theta}{\delta t}$, at a certain temperature θ in 2, the heat loss 'dQ' in an interval 'δt' can be calculated from (1) and if the superficial area of the cooling body be known, the rate of heat loss per unit area is also easily calculated. This gives the *total* heat loss. If the body be assumed to be behaving as a black body, the rate of heat loss due to radiation per unit area from it can be calculated by the Stefan-Boltzmann Law. Thus if its temperature be T°A & T°_0A be the temperature of the surroundings, this is given by, $\sigma(T^4\text{-}T_0^4)$ where 'σ' is Stefan's constant. The assumption that the body is behaving like a black body is highly artificial but it gives an upper limit of the heat loss due to radiation. Comparing this value with the one which gives the total heat loss, as calculated above, the relative contribution of radiation is computed. For a small difference of temperature of 5°C. between the body and surroundings, the results of an experiment on the above lines show that the contribution of radiation is 75%. Thus convection is certainly responsible for 25% of heat loss and obviously more than 25%, as the body is not a black body. This dispels the confusion sometimes prevailing that it is radiation which is the all important factor.

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March 19, 1950.

INTENSITY OF RAMAN LINES IN BARYTES

THE temperature variations of the intensities of the Stokes and anti-Stokes Raman lines in barytes have been investigated by the author. The method of intensity measurements adopted has been described in a previous communication.[1] All the Stokes lines, lattice as well as internal, were found to decrease in intensity with rise of temperature while the anti-Stokes line corresponding to 73·6 cm.$^{-1}$, 462 cm.$^{-1}$, and 988 cm.$^{-1}$, showed a conspicuous increase with the rise of temperature. The relative intensities for the 988 line are listed in Table I and the S/A.S. ratio for the 73·6 cm.$^{-1}$ line in Table II.

TABLE I

Temperature	Stokes 988 cm.$^{-1}$		Temperature	Anti-Stokes 988 cm.$^{-1}$	
	Observed	Calculated		Observed	Calculated
300° K.	1	1	300°	1	1
427°	·84	1·03	363	1·3	2·3
517°	·79	1·06	427	2·2	4·2
525°	·7	1·09			

TABLE II

Ratio S/ A.S. 73·6 cm.$^{-1}$ Raman line

Temperature	$e^{\frac{h\nu_s}{kT}}$	$\left(\frac{\nu-\nu_s}{\nu+\nu_s}\right)^4 e^{\frac{h\nu_s}{kT}}$	Observed value
300° K.	1·42	1·40	1·35
427	1·28	1·26	1·25
517	1·23	1·21	1·20
595	1·19	1·18	1·15

There is a decrease in intensity of the Stokes lines instead of the theoretically[2] expected increase and the anti-Stokes increases with rise of temperature but to a smaller extent. In the case of $C\,Cl_4$ such a discrepancy has been explained as being due to the anharmonicity introduced by centrifugal force due to rotation.[3] In the other cases that have been studied it has been attributed to the expansion of the series polarizability α as $\alpha_0 + \Sigma \left(\frac{\partial \alpha}{\partial q}\right)_0 q + \ldots$ by Taylor being not valid for large values of q.[4] This latter explanation is not correct as the Taylor series expansion must be true though there is a dependency of $\left(\frac{\partial \alpha}{\partial q}\right)_0$ on temperature as a result of anharmonicity. Even when an attempt is made to take into account this anharmonicity by using the wavefunction obtained from the Morse function instead of that of a simple harmonic oscillator, the intensity of the Stokes line should only increase though to a different extent, with rise of temperature. So in an actual case, if it is assumed that the scattering from molecules in the higher states is not much more than those in the lower states and that transitions involved in the formation of the Stokes line are less probable than those in the case of the anti-Stokes line, we can understand the observed decrease in intensity of the Stokes line with the rise of temperature.

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March 22, 1950.

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ABSORPTION SPECTRA OF TELLURIDES OF ANTIMONY AND BISMUTH

THE author has studied the absorption spectra of SbTe and BiTe molecules in the vapour state at high temperatures using a graphite electric furnace. None of these molecules has been studied previously, either in emission or in absorption. Several band systems have been observed and studied in detail. The band-heads have been measured and the band systems analysed. The following table gives the various band systems observed and the values of the molecular constants deduced from the vibrational analysis of these systems.

TABLE I

Molecule	System	Region in A U.	ν_e	ω_e''	$\omega_e''\chi_e''$	ω_e'	$\omega_e'\chi'_e$
SbTe	I	2383–2260	43553	284·4	0·20	314·50	0·48
BiTe	I	2942–2814	..	208·5	0·52	..	..
BiTe	II	2454–2382	..	208·5	0·52	..	..
BiTe	III	2390–2315	42870	208·5	0·52	164·40	0·42
BiTe	IV	2374–2279	43116	208·5	0·52	263·00	0·96
BiTe	V	2276-2200	..	208·5	0·52	..	..

For all these band systems analysed Condon parabolæ have been drawn. These, in general, are narrow as would be expected from the nearness of ω_e'' and ω_e' values.

In some of these measurements the absorption bands of the metals Sb_2 or Bi_2, also appeared prominently. These spectra however, are easily identified since they are well known from the detailed studies of Nakamura and Shidie, Almy and Sparks. Fortunately they do not overlap with the spectra of the SbTe or BiTe molecule and hence do not interfere with the present measurements.

The author wishes to express his thanks to Sir K. S. Krishnan, F.R.S. under whose supervision the work was done.

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March 13, 1950.

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ABSORPTION SPECTRA OF ANTIMONY AND BISMUTH SELINIDES

THE absorption spectra of SbSe and BiSe have been studied in the vapour state at high temperatures using a graphite electric furnace. None of these molecules has been studied previously either in emission or in absorption. Several band systems have been observed and studied in detail by the author. The band-heads have been measured and the band systems analysed. The following table gives the various band systems observed and the value of the molecular constants deduced from the vibrational analysis of these systems.

For all the band systems analysed Condon parabolæ have been drawn. These, in general, are narrow as could be expected from the nearness of ω_e'' and ω_e' values.