For an isotropic medium the four elastic properties are related to one another by the following equations:

$$Y = 2\mu(1 + \sigma) \tag{II.1}$$

and

$$\frac{1}{\chi} = B = \frac{Y}{3(1 - 2\sigma)} \tag{II.2}$$

where Y is Young's modulus, μ is the shear modulus, σ is Poisson's ratio, χ is the compressibility, and B is the bulk modulus. The compressibility and the bulk modulus are considered to be one elastic property, since one is the reciprocal of the other. It is seen from Eqs. (II.1) and (II.2) that if two of the elastic properties are known, the other two may be calculated; i.e., any one of the four elastic properties may be expressed in terms of two of the remaining three. The twelve possible equations have been summarized by Köster and Franz[12] and therefore are not repeated here.

In general the values listed for each of the four elastic properties were obtained experimentally. In a few instances when an experimental value was not available, and when values of two of the other elastic properties were given, the values for the other two properties were calculated. This procedure is valid if the two experimental values pertain to the same material; if, however, they pertain to different samples, then the above procedure may not be valid. Values calculated from data taken from different samples are identified by footnotes in the tables. Fortunately, this procedure led to consistent results for all but selenium (this is discussed in Section 5).

3. Young's Modulus

Values for Young's modulus, also known as the elastic modulus, are listed in Table I, and are shown in Fig. 1 for the elements of the fourth, fifth, and sixth periods of the Periodic Table. It should be noted that Young's modulus varies between 0.0361×10^6 kg/cm^2 for potassium to 11.5×10^6 kg/cm^2 for diamond. Estimated values, however, would indicate that the lower limit is probably 0.017×10^6 for francium. The magnitude of Young's modulus appears to be dependent on the electronic configuration of the element, i.e., the group in which it lies. The maximum value encountered in a given period is associated with the elements having the maximum number of unpaired d electrons. As will be noted, this behavior is observed in a number of other physical properties. The anomalous behaviors of manganese, iron, cobalt, and nickel (Fig. 1), as compared with those of their cogeners of the fifth and sixth periods, are also evident

[12] W. Köster and H. Franz, *Met. Rev.* **6**, 1 (1961).

Table I. Young's (Elastic) Modulus

Element	$Y \times 10^{-6}$ (kg/cm^2)	Ref.
3 Li	0.117[a,b]	1
4 Be	3.04 ±0.12	2, 3, 4
5 B	4.50	5
6 C(g)	0.0849 ±0.0025	6
6 C(d)	11.5 ±1.3[b]	7
11 Na	0.0912[b,c]	1
12 Mg	0.452	3
13 Al	0.724	3, 8, 9
14 Si	1.05 ±0.10	10, 11
15 P(w)	(0.047)[d]	—
15 P(r)	(0.194)[d]	—
15 P(b)	(0.307)[d]	—
16 S(r)	0.198[b]	7
19 K	0.0361[b,c]	1
20 Ca	0.200	3
21 Sc	0.809	12
22 Ti	1.08 ±0.4	3, 4, 13
23 V	1.34 ±0.05	4, 14
24 Cr	2.48 ±0.04	15
25 Mn	2.02	3
26 Fe	2.14 ±0.03	3, 16, 17
27 Co	2.10 ±0.02	3, 17
28 Ni	1.97	17
29 Cu	1.26 ±0.06	3, 9, 16
30 Zn	0.940	3
31 Ga	0.944[b,e]	18
32 Ge	1.01	19
33 As	(0.398)[d]	—
34 Se	0.591[f]	20
37 Rb	(0.0277)[d]	—
38 Sr	(0.139)[d]	—
39 Y	0.661 ±0.015	21, 22
40 Zr	0.939 ±0.004	4, 23, 24
41 Nb	1.07 ±0.01	4, 25, 26
42 Mo	3.34 ±0.10	3, 16, 27, 28
43 Tc	(3.76)[d]	—
44 Ru	4.20 ±0.02	20, 29
45 Rh	3.80 ±0.06	3, 16
46 Pd	1.26 ±0.02	3, 16
47 Ag	0.822 ±0.010	3, 16, 30
48 Cd	0.635	3
49 In	0.107	3
50 Sn(g)	0.534	31
50 Sn(w)	0.550	3
51 Sb	0.560	3
52 Te	0.42	32