substance had been found in certain marine productions; and it struck the author that burnt sponge (a well-known remedy for goitre) might owe its properties to the presence of Iodine, and this was his motive for making the trial. He lost sight of the case in which the remedy was employed, before any visible alteration was made in the state of disease; but not before some of the most striking effects of the remedy were observed. The above employment of the compounds of Iodine in medicine was at the time made no secret; and so early as 1819, the remedy was adopted in St. Thomas's Hospital, by Dr. Elliotson, at the author's suggestion.

The above quotation is taken from "Chemistry, Meteorology and the Function of Digestion," by William Prout, M.D., F.R.S. The book ran through three editions, the first of which appeared in 1834. Prout himself is best known for his intriguing hypothesis about the constitution of matter, but devoted most of his energy to medical practice and made several important contributions to the use of chemistry in medicine. John Elliotson, F.R.S., referred to in the above quotation, was "without doubt foremost among the eminent physicians of the day."[2]

Thus, the use of iodine in the treatment of goiter was known to at least two "eminent physicians." The speculations now in order are legion.

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GENETICS, SULFHYDRYL AND CANCER

THE discovery that the –SH group is a naturally occurring chemical stimulus to cell increase in number[1] produced the suggestion that ". . . the potentiality for malignancy lies in the hereditary determination of lines of cells retaining the embryonic characteristic of a heightened sensitivity to . . . sulfhydryl. . . ."[2]

A critical point in this idea—which was not advanced as dogma but as a base from which exploration could be made—was the unproved concept that deviations in reactivity to or production of such an ubiquitous and environmentally sensitive chemical group as the sulfhydryl should be subject to or even determined by genetic factors.

Recently evidence has come from other laboratories than ours that genetic constitution does play a part in sulfhydryl matters. Thus Gregory and Goss[3] find positive correlation between potential racial size (which Painter[4] has shown to be correlated with rate of cell division) and glutathione (–SH) concentration in newborn Flemish and Polish rabbits and their hybrids. From their results they state "the data at hand indicate that a genetic constitution for a given adult size maintains a certain glutathione level which in turn regulates the rate of cell proliferation and growth by increase in cell number."

More recently Martin and Gardner[5] report results which indicate liberation of cysteine (–SH) from glutathione is also conditioned by genetic factors. Thus in the hairless rat neither cystine nor glutathione (R–S. S–R) as such produce reaction, while "Cysteine through the sulfhydryl group acts as a stimulant to the hair follicle, bringing about a trichogenic action in hereditary hypotrichosis of the rat."

Though in geometry "two things which are equal to the same thing are equal to each other," the same does not necessarily hold in biology. The mere fact that heredity plays a part in cancer potentiality, that cell proliferation is a large factor in malignant growth, that cell proliferation is enhanced by sulfhydryl, and that this may be genetically determined, may or may not mean anything with respect to the suggestion that inherited disturbance in productivity of or sensitivity of sulfhydryl may be a significant factor in malignancy.

Perhaps these correlations are not functional—but their appearance is provocative.

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SCIENTIFIC BOOKS

ATOMIC SPECTRA

The Theory of Atomic Spectra. By E. U. CONDON and G. H. SHORTLEY. Cambridge University Press, pp. 431, 1935.

A VERY useful summary of most of the calculations available at present on the theory of spectra. The subject is clearly and logically presented. The mathematical tools used are as elementary as possible and the book should be therefore readily assimilated by a large circle of readers. Its main strength lies in a complete and careful compendium of most of the available results of calculations of energy matrices in various types of coupling. These are presented in Chapter XI for intermediate coupling, while in Chapter XII the transformations to various cases of pure coupling are thoroughly discussed. Chapter XIII is especially devoted to configurations containing almost closed shells and discusses the subject very thoroughly.

[2] Dictionary of National Biography, Vol. XVII, p. 265.

[1] *Protoplasma*, 7: 297, 1929.

[2] *Archives Pathol.*, 8: 575, 1929.

[3] *Jour. Exp. Zool.*, 66: 155, 1933.

[4] *Jour. Exp. Zool.*, 50: 441, 1928.

[5] *Jour. Biol. Chem.*, 111: 193, 1935.

The computational side of the theory is nicely tidied up. Any one working in the subject knows that it is very time-consuming to apply the results available in the literature on account of the large variety of notations and conventions used about signs of wave functions, normalizing factors and other similar details. It is in fact often found that a paper dealing with energies in Russell Saunders coupling may be completely useless in applications to cases of intermediate coupling, because the author may find it expedient to avoid using wave functions altogether. It is very usual that in a new application of the theory one has to rework all previous applications from the beginning, so that, for example, calculations performed by Mr. Johnson on the energies of a configuration in intermediate coupling can be used by Mr. Wills only as a check when he wishes to work out formulas for the hyperfine structure of the same configuration. It is very gratifying that Condon and Shortley have systematized the subject by standardizing conventions as to signs and normalizing factors. By so doing they make the existing literature readily available for future applications and extensions.

The tidying up process is facilitated by a rational treatment of spherical harmonics which was supplied to the authors by H. P. Robertson and is given towards the beginning of the book. This choice of spherical harmonics which is used corresponds to those simple forms of angular momentum matrices which were introduced with the beginning of matrix mechanics. These are more practical than the cumbersome sign conventions inherited from old-fashioned mathematics. In the symbolic method used with success by Weyl, Wigner, Kramers, Brinkman, they correspond to $\binom{2l}{l+m} \xi^{l+m} \eta^{l-m}$. If the book were not confined to the use of elementary methods one could further understand the summation theorem as follows. Let $Y_l^m(I)$, $Y_l^m(II)$ be the above-mentioned spherical harmonics of two directions I and II normalized so as to have $\int [Y_l^m]^2 d\Omega = 1$ where Ω is the solid angle. Then one sees with little trouble that $\Sigma Y_l^{m*}(I)\ Y_l^m(II)$ is a rotational invariant and therefore depends only on the angle θ between the directions I and II. Since the sum satisfies Laplace's equation it is a multiple of the Legendre function $P_l(\cos\theta)$. Remembering that $Y_l^0 = [(2l+1)/4\pi]^{1/2} P_l$ and making $I = II$, it follows that the above sum is $(2l+1)P_l/4\pi$.

The discussion of the composition of angular momenta (p. 57) is presented clearly from an elementary point of view. It appears to presuppose the existence of wave functions corresponding to the composed angular momenta. The existence of such functions can be elucidated by observing that an operation with $J_x - iJ_y$ on the function in the $j_1 + j_2$ column gives a linear combination of the two functions in the $m_1 + m_2 - 1$ column and that therefore one of the two solutions of the secular determinant for J^2 formed on the functions of the $m_1 + m_2 - 1$ column belongs to $J^2 = j(j+1)$. Similarly, one sees that at least one of the functions in all columns belongs to this same value of J^2. In a similar way one proceeds with the other values of J^2 by orthogonalization.

On p. 60 we find Dirac's tricky way of proving the selection rule $\Delta j = \pm 1, 0$. In spite of the ingenuity of this method it seems also advisable to look at the matter from a different point of view which simultaneously presents the intensity sum rule in the Zeeman effect without detailed calculation. Referring to the magnetic quantum numbers of the upper level by μ and to those of the lower level by m, one shows that $\Sigma_m \{ |x_{\mu m}|^2 + |y_{\mu m}|^2 + |z_{\mu m}|^2 \}$ is independent of μ by noticing that this sum is a special case of the sum $\Sigma_m \{ x_{\mu m} x_{m\mu'} + y_{\mu m} y_{m\mu'} + z_{\mu m} z_{m\mu'} \} = Q_{\mu\mu'}$. This sum commutes with the three components of the angular momentum J and is therefore a constant times the unit matrix. This view is a natural one because it makes direct use of the rotational invariance of the transition probability. Similarly, $\Sigma_\mu \{ x_{m\mu} x_{\mu m'} + \cdot\cdot \} = P_{mm'}$ is a multiple of the unit matrix. The selection rules for m now show that if $|\Delta j| > 1$ there is always a magnetic level of the level with the greater j for which either Q or P is zero and that therefore if $|\Delta j| > 1$, P and Q are zero for all magnetic sublevels. The additional exclusion of $j = 0$ jumping into $j = 0$ follows from spectroscopic stability for polarization, which in turn is a consequence of the invariance of a spur under unitary transformations. Although these methods of presentation are closely related to discussions by means of group theory, they are sufficiently elementary to be universally digestible and appear to be more directly related to the physics involved than the algebraic procedures introduced in the early literature and frequently reproduced in books.

It is particularly nice to see frequent comparisons of theory and experiment throughout the book. Most of this is available in the literature, but the combined effect of the graphical comparison between theory and experiment is very convincing as to the essential correctness of the usual form of theory.

The computer of theoretical spectroscopic relations will be delighted to find on pp. 76–77 tables of transformation coefficients for vector coupling between an arbitrary angular momentum j_1 and angular momentum $j_2 = \frac{1}{2}, 1, \frac{3}{2}, 2$. The section on the theory of radiation also adds materially to the value of the book, although it does not pretend to be an exhaustive or learned account. It is regrettable that the spin orbit interaction in many-electron spectra is introduced pretty much by analogy with one-electron spectra without the theoretical justification which is available.

In the study of the section on hyperfine structure, the reader may be helped by the following remarks. For single-electron spectra all the formulas given can be summarized by $\Delta w = \frac{a}{2}[f(f+1) - i(i+1) - j(j+1)]$; $a = \frac{2g\mu_0^2 l(l+1)}{1840\, j\,(j+1)} \cdot \overline{\left(\frac{1}{r^3}\right)}$ where for $l=0$ one should use the limiting value $l(l+1)\overline{r^{-3}} = 2\,\pi\psi^2\,(0)$ and the nuclear g factor is expressed in terms of the theoretical magnetic moment of the proton. The energy expression for the lowest ^3S term of Li which is given by

$$1.06\frac{8\pi}{3}\mu_0\,M\psi^2\,(0)\,\left(-\frac{5}{3},\,-\frac{2}{3},\,1\right)$$

as Equ. (1) on p. 425 takes into account the influence both of the 1s and the 2s electrons. The correction for the 2s electron is represented by the factor 1.06 and has been computed by two independent methods, one of which consists in a variational calculation of the cartesian coordinate wave function. The present status of calculations on hyperfine structure in intermediate coupling is that deviations from theory are of the correct order of magnitude to be explicable as due to the same cause as the deviations of properties of gross structure from theory. This conclusion has been arrived at by comparing expressions for wave functions derived from different properties of the gross structure such as intervals and the Landé g factors for the Zeeman effect. This study therefore indicates that the interaction between configurations is related to the deviations of hyperfine structure from the theoretical relations which correspond to simple configuration assignments.

The book contains many neat and useful points which add to its value as a general reference volume. Thus on page 127 one finds a neat explicit representation of functions for Dirac's equation in a central field leading to the two radial equations which are so useful in applications. Here also one finds Darwin's reduction of the Dirac equation to the Pauli spin form, but one should be cautioned against applying this form to hyperfine structure. Similarly, one finds reference to the use of Dirac's vector model made by Van Vleck and a detailed summary of self-consistent field calculations.

G. BREIT

SPECIAL ARTICLES

GROWTH IN HEIGHT AND WEIGHT IN COLLEGE AND UNIVERSITY WOMEN

MEAN height and weight measurements of college and university women, when obtained from independent samples of the population at successive ages, have revealed no consistent changes associated with advancing age.[1] Consecutive annual measurements made upon the same individuals do not confirm this result.[2] They indicate that there is a small but significant increase in these measures of physique throughout the four college years. These contradictory findings prompted the present investigation in which the same data are subjected to the two different types of analysis. The data were made available to us by the Department of Physical Education for Women at Stanford University.

Height and weight measurements were assembled from 1,290 individuals. Of these 1,134 were remeasured after one year, and 446 after two years. In assigning the measurements to specific ages, a certain degree of arbitrariness could not be avoided because the time at which measurements were made varied widely with respect to the subjects' birthdays. We assigned to a given age-group any measurement that was made within an interval of six months preceding and six months following the birth date. The majority of remeasurements followed first measurements with an interval closely approximating one or two years. The means of the intervals are 11.5 and 23 months, respectively.

When these data are analyzed by computing the mean measurements for independent samples at the successive ages, we obtain the results presented in Table 1. If two or more annual measures were avail-

[1] Fritz Bach, *Zeits. f. Konstit. lehre*, 16: 28–62, 1931; H. S. Diehl, *Human Biology*, 5: 600–628, 1933; H. N. Gould, *Research Quart. of the Amer. Physical Ed. Assn.*, 1: 1–18, 1930; C. M. Jackson, *Am. Jour. Physical Anthrop.*, 12: 363–413, 1928.

[2] B. F. Baldwin, *Univ. Iowa Studies: Stud. Child Welfare*, 1: pp. 411, 1921; H. N. Gould, *ibid.*

TABLE 1

HEIGHT AND WEIGHT DATA FOR WOMEN STUDENTS AT STANFORD UNIVERSITY. (INDEPENDENT SAMPLES AT EACH AGE; NO REMEASUREMENTS)

Age	N	Height (inches)			Weight (pounds)		
		Mean	S.D. mean	S.D. dist.	Mean	S.D. mean	S.D. dist.
17	331	64.75	.09	1.69	124.85	.85	15.72
18	553	64.71	.09	2.19	123.05	.65	15.31
19	263	64.72	.14	2.26	123.24	.98	15.84
20	94	64.63	.23	2.28	120.90	1.41	13.70
21	49	64.54	.34	2.37	125.56	2.80	19.58