Part III, "Methods of Spatial Comparison," is an extension of Part II to indicate how statistical characteristics of the elements at one point are to be compared with those at other points. This includes reduction to standard period and epoch, correlation coefficients, graphs, maps, anomalies, roses and streamlines. Included here are integrated or synthetic elements such as continentality, air-mass climatology and climatic boundaries. Unfortunately, the discussion of and examples of streamlines are not very sound nor sufficiently explicit, but the matter is not of great importance. Part IV, "The Climatography," indicates briefly the desired type and organization of contents of a monograph on the climate of a region.

There is much room for difference of opinion as to the proper methods to use in a descriptive climatology. This review is not the place to introduce other approaches; but we do miss any reference to the new Russian methods. Dr. Conrad has given us an excellent account of the methods found in the German literature, to which he himself has made many interesting contributions, and organized them according to a well-established and consistent point of view. It will be a firm starting point for the new generation of climatologists now emerging.

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ANALYTICAL GEOMETRY

Analytical Geometry of Three Dimensions. By W. H. MCCREA. (University Mathematical Texts, No. 7.) vii + 144 pp. Edinburgh: Oliver and Boyd. New York: Interscience Publishers. 1942. $1.75.

THIS is a remarkably concise exposition which is at the same time rigorous and easy to read. It could not be recommended (and was not intended) for a student who has no supplementary help; but it is a university text, which means that it will, as the author says, "be used in connection with lectures or other personal instruction." The opening chapters, on "Directions, Planes and Lines," and "The Sphere," are orthodox but neatly expressed. (The third includes a good account of stereographic projection.) Then "Points at Infinity" are introduced in an unusually careful manner. Homogeneous coordinates are used to determine a space $\bar{\mathcal{E}}$, part of which is isomorphic with the Euclidean space $\mathcal{E}$ previously considered. The remaining "special" points of $\bar{\mathcal{E}}$ are defined on page 43, but it is not until page 51 that our suspense is relieved by the proof that "two ordinary lines are parallel if and only if they meet in a special point."

Chapter V may seem more difficult to some readers, but a careful study of it will be found well worth while. Here quadrics are classified first in $\bar{\mathcal{E}}$ and then in $\mathcal{E}$. The results are very neatly tabulated. The general quadric is denoted by

$$a_{rs}\, x_r\, x_s = 0$$

in accordance with Einstein's convention of summation. Chapter VI, on Standard Forms, is enlivened by instructions for making solid models. The final chapter deals interestingly with some extra topics such as twisted cubics and confocals. In particular, a focus of a quadric is defined (on page 134) as a point which is the vertex of a single infinity of orthogonal conjugate trihedra. It is proved that the foci constitute an ellipse in one plane and a hyperbola in another and that any focus which lies on the quadric is an umbilic.

To quote the author's preface again, "Care has been taken to frame the theory so that it does strictly apply to *real* space. This explains the avoidance of certain familiar short-cuts, which actually depend on jumping difficulties about reality conditions."

Possibly more use might have been made of the duality (in $\bar{\mathcal{E}}$) between point-coordinates and plane-coordinates (compare P. W. Wood's tract on "The Twisted Cubic," Cambridge, 1913, or A. Robson's "Introduction to Analytical Geometry," Cambridge, 1940, where this duality is indicated by the consistent interchange of small and capital letters). The author shows on page 70 that "the necessary and sufficient condition for a plane to be a tangent plane is that it should contain its pole," and that the pole of a given plane $[\xi_1, \xi_2, \xi_3, \xi_4]$ is obtained by solving the equations

$$a_{rs}\, y_r = \xi_s.$$

The customary work on page 84 could have been simplified by carrying out this solution in the form

$$y_s = b_{rs}\, \xi_r,$$

which shows that the condition for ξ to contain its pole is

$$b_{rs}\, \xi_r\, \xi_s = 0.$$

Again, the cross ratio of four collinear points (page 52) and of four coaxial planes (page 53) might have been deduced simultaneously from the expression

$$\frac{(\xi \cdot \mathrm{x})\,(\eta \cdot \mathrm{y})}{(\xi \cdot \mathrm{y})\,(\eta \cdot \mathrm{x})}$$

which is valid for any two points and two planes $\mathrm{x}, \mathrm{y}, \xi, \eta$.

But these are minor criticisms, and on the whole this is probably the best text-book ever provided for university teaching of analytical stereometry. The printing is excellent. Apart from some missing letters at the beginning of two lines on page 130, the only error detected was the transposition in "Joachimstahl" on page 59. Finally, there is a good index.

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COLORIMETRIC DETERMINATION OF TRACES OF METALS

Colorimetric Determination of Traces of Metals. By E. B. SANDELL. 487 pages, with index. Cloth

bound. New York: Interscience Publishers, Inc. 1944. $7.00.

THE first part of this book describes theory and practice of colorimetry and covers the subject of sampling, reagents, blanks, and the preparation of solutions. About a score of general colorimetric reagents, including dithizone, thionalide and hydrogen peroxide, are discussed.

The second part, from page 113 to the index, consists of procedures for the determination of traces of metals. The author has adopted the desirable practice of showing how to separate interfering elements so that the reader can see the limitations as well as the applicability of the methods. The discussions include quite a range of determinations, for example, chromium in silicate rocks, in iron ore, and in biological materials; lead in silicate rocks, in water, and in biological materials; and rhenium by various methods in molybdenite and pyrolusite. Usually more than one method is given so that the analyst has some choice depending upon the nature of the substance to be analyzed.

To an analyst it is always gratifying to read a book or use a method that conveys the feeling that the subject-matter is based on the experience of the author. This is such a book and should find a place on the desk of any analyst interested in the determination of traces of metals. It is to be regretted that more elements are not included, especially the more common non-metals that are so common in silicate rocks and metallurgical products. Another volume including these is desirable.

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SPECIAL ARTICLES

ON THE NATURE OF REFRACTORINESS OF CERTAIN GRAM-NEGATIVE BACILLI TO PENICILLIN[1,2,3]

GRAM-NEGATIVE bacilli are described as highly resistant to penicillin,[4] the fact being interpreted as an intrinsic difference between Gram-negative bacilli and the susceptible Gram-positive microorganisms. It was recently reported by the author of this article that *E. coli* is significantly more susceptible to the drug than hitherto assumed. The inhibitory effect may be obscured by tests against an excessively large number of organisms, the bacterial concentration at zero hours bearing a linear relationship to the concentration of penicillin producing complete inhibition. Furthermore, the susceptibility of *E. coli* could be significantly enhanced when the tests were made in mixtures of methionine with normal sera.[5] The observations suggested that the refractoriness of Gram-negative bacilli may at least in part result from the interference of some medium-ingredients or bacterial metabolites with the action of penicillin. In order to investigate this assumption autotrophic strains of Gram-negative bacilli, *i.e.*, capable of growing abundantly in synthetic media with ammonium as sole source of nitrogen, were selected for study. The measurements of penicillin activity were made in the manner previously described.[5] The organisms were cultured for a number of generations in the synthetic medium of Gladstone.[6] The same medium was used as diluent and for testing. As may be seen from Table 1, the susceptibility of the organisms to penicillin was markedly greater in the synthetic medium than in meat infusion broth. The following studies were made in order to determine the nature of the antagonism observed.

TABLE 1

COMPARISON OF INHIBITORY EFFECT OF PENICILLIN UPON E. COLI IN MEAT INFUSION BROTH AND SYNTHETIC MEDIUM (GLADSTONE)

Microorganism*	Medium	Penicillin in O.U./ml giving complete inhibition	Coefficient resistance†	Increase in susceptibility in Gladstone medium
E. coli No. 42	Broth	20	1000‡/50	20×
	Gladstone	1		
E. coli No. 742	Broth	>50	>2500/500	>5×
	Gladstone	10		
S. Newport	Broth	2	100/10	10×
	Gladstone	0.2		
S. Paratyphi B	Broth	3	150/75	2×
	Gladstone	1.5		
S. Enteriditis	Broth	8	400/50	8×
	Gladstone	1		

* The number of organisms at zero hours was 0.75×10^6 per ml.

† Taking as one unit of resistance the amount of penicillin required to produce complete inhibition of Staphylococcus H, 5×10^2 organisms per ml at zero hours.

‡ Lower concentrations of penicillin are required to inhibit smaller numbers of organisms at zero hours.[5]

[1] From the Division of Bacteriology, Laboratories of the Mount Sinai Hospital, New York, N. Y.

[2] The author wishes to acknowledge thankfully the accurate and capable assistance of Miss Alice Fisher.

[3] The penicillin was provided by the Office of Scientific Research and Development from supplies assigned by the Committee on Medical Research for clinical investigations recommended by the Committee on Chemotherapeutics and Other Agents of the National Research Council.

[4] E. P. Abraham, *et al.*, *Lancet*, 2: 177, 1941; J. Florey, *Brit. Jour. Exp. Path.*, 23: 120, 1942; C. L. Hobby, R. Meyer and E. Chaffee, *Proc. Soc. Exp. Biol. and Med.*, 50: 281, 1942.

[5] Gregory Shwartzman, SCIENCE, 100: 477, 1944.

[6] G. P. Gladstone, *Brit. Jour. Exp. Path.*, 18: 322, 1937.