tiplication, problems which with us would lead to equations were solved by a process of trial, a general rule was often derived from special numerical examples. In the same way to-day mathematicians by a kind of induction often find a rule from a special example, but this must afterwards be proved.

One receives the impression from Professor Peet's work that the mathematics of the Egyptians was developed largely in caring for the needs of their daily life. On the other hand, in a recent account of the Edwin Smith Medical Papyrus, J. H. Breasted, professor of Egyptology and Oriental history at the University of Chicago, has expressed the opinion that the surviving mathematical papyri clearly demonstrate the Egyptian's scientific interest in pure mathematics for its own sake. With this point of view I am in entire sympathy. To me the whole papyrus seems to be constructed on a scientific basis, and is not a mere collection of problems for practical use. Easier problems come before more difficult ones in the same way as in a modern arithmetic.

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LABORATORY APPARATUS AND METHODS

INDICATOR REACTION AS A SOURCE OF ERROR IN pH DETERMINATIONS

THE colorimetric determinations of hydrogen-ion concentrations, expressed as pH, are now a part of routine procedure in various lines of work. In many cases no electrometric check is feasible and the prevention of errors incident to the preparation and use of standard buffer and indicator solutions is of paramount importance. The purpose of this paper is to point out one of these errors, that is, the change of reaction of indicator solutions stored in glass bottles. It has been found that such a change will in many cases seriously affect the results obtained and that the use of the same indicator solution in both the standard and the unknown solutions does not remove this error.

In the course of some determinations of the pH of soil extracts it was found that the readings were in several cases too high (*i.e.*, alkaline) and change in the reaction of the indicator solutions used, probably due to alkali dissolved from the storage bottles, was found to be the cause. Forty-three soils were tested with indicators both unadjusted and corrected as to reaction, and, of these, twenty-two showed a difference in readings of from .3 to .9 between the adjusted and the unadjusted indicator solutions. The usual experimental error in determinations of this kind is less than .2. Buffer solutions tested under similar conditions showed no differences of color. The need for

such indicator adjustment has been noted by Karraker in his recent paper on soil reaction studies.[1]

It is in some cases necessary to adjust the reaction of the indicator solutions quite frequently, and it has been found that a convenient means for doing this, when electrometric apparatus is not available, is by the "spot" method. An ordinary porcelain plate used for color reactions is suitable for this purpose. Twenty milliliters of the indicator to be adjusted are taken from the stock bottle and a drop placed in one of the depressions on the plate. A drop of N/20 hydrochloric acid is then added to the 20 ml. and another drop placed on the plate. This procedure is repeated until the acid color is reached. A spot is now selected which corresponds as nearly as possible to the color midway of the workable range of the indicator. A buffer solution of the desired pH plus the indicator being tested may be used for comparison or the colors in the excellent chart in Clark's book on hydrogen ion concentrations[2] may be referred to. The use of this chart provides a simple and efficient method of comparison as the flat colors more nearly approach the "spot" colors for comparative purposes than do the tubes of standard buffer solutions. The proper "spot" may also be approximated by selecting the one in which the two component colors of the indicator appear most nearly equal. Having decided on the proper color a quantity of the stock indicator solution is adjusted to this point by the addition of a calculated amount of N/20 hydrochloric acid. It will be found, after repeating this procedure once or twice, that the "midway" color can be readily determined without a preliminary 20 ml. test.

For highly buffered solutions this adjustment of the reaction of the indicator is apparently unnecessary, but for unknown solutions or those of known low buffer content it is essential, for if this source of error is disregarded there can be no assurance as to the accuracy of the results obtained.

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SPECIAL ARTICLES

OBSERVATIONS ON TAXONOMIC FACTORS USED IN THE GENUS CERCOSPORA

THE fungi which are included in the genus Cercospora have been and still are classified on the basis of spore size, host reaction to parasite and known host range of the causal organism. This taxonomic

[1] "A Note on Soil Reaction Studies," P. E. Karraker, *Soil Science*, Vol. 15, No. 6.

[2] "The Determination of Hydrogen Ion Concentrations." (1922 Edition.) W. Mansfield Clark.

method presupposes (1) that environmental factors such as moisture and temperature exert little if any influence on the size of fruiting structures, (2) that the inherent differences in host plants do not affect the size of spores, and (3) that the reaction of the host is a response to a definite and specific stimulus of the organism.

For their bearing on this subject the following observations are submitted. They are the results of work done during 1921–1922, in Central Luzon, Philippine Islands.

CULTURAL STUDIES

The following organisms were isolated and studied in pure culture on various media: *Cercospora lussoniensis* Sacc. on *Phaseolus lunatus, C, manihotis* P. Henn. on *Manihot utilissima, C. melongenae* Welles on *Solanum melongena, C. duddiae* Welles on *Allium cepa,* and *C. averrhoi* Welles on *Averrhoa carambola.*

On nutrient agar, potato glucose agar, agar decoctions of the various host tissues and on cooked corn meal, the organisms appeared similar with the exception that when they were young the growth of each organism was slightly enhanced by the decoction made from its respective host plant tissue.

SEASONAL VARIATION IN SPORE SIZE

Conidiophores and conidia from lesions on the following hosts were measured during the dry and during the rainy season: *Dolichos lablab (Cercospora* sp.), *Ipomoea batatas (C. batatae), Phaseolus lunatus (C. lussoniensis), Psophocarpus tetragonolobus (Cercospora* sp.), *Sesamum orientale (C. sesami), Solanum melongena (C. melongenae).*

The measurements obtained disclosed the fact that the fruiting structures were anywhere from 50 to 150 per cent. longer when produced in the rainy season. The great variant during the rainy season appeared to be moisture, and it was conjectured that this might be one of the main factors responsible for the increase in length of spores. Therefore, further experiments were performed.

EFFECT OF MOISTURE ON SPORE SIZE

Leaf-spotting diseases of the Cercospora type, while very abundant in the rainy season, are noticeably scarce during the drier periods. The following organisms were found in sufficient abundance in the dry season to allow of experimentation: *C. averrhoi, C. batatae, C. nicotianae* and *C. personata.*

By tying wax-paper bags containing rather large pieces of water-saturated cotton over leaves bearing lesions, it was possible to increase the relative humidity of the atmosphere to which the leaf was exposed, appreciably, for three or four days. After the leaves were exposed to this treatment for the period of time just mentioned, it was found that conidial length was increased from 30 to 80 per cent. over the measurements made from spores from undisturbed field lesions collected at the same time. Conidiophores were absent on all hosts used, with the exception of *Arachis hypogoea,* when the material was collected under normal field conditions. However, upon the addition of moisture, conidiophores of lengths as great as 130 microns were commonly produced.

HOST INFLUENCE ON SPORE SIZE

Phaseolus lunatus, Dolichos lablab, Curcurbita maxima, Glycine max, Ipomoea batatas, Macaranga tanarius, Manihot utilissima, Phaseolus aureus, Psophocarpus tetragonolobus, Ricinus communis, Sesamum orientale, Vigna cajang and *Vigna sinensis* were inoculated with pure cultures of *Cercospora lussoniensis* isolated from *Phaseolus lunatus.*

The measurements obtained from fruiting structures produced by these inoculations varied from 71.9 to 126.5 microns for the minimum lengths of the conidia and 127.9 to 236.0 microns for the maximum lengths. In making the inoculations an attempt was made to obtain parallel conditions of moisture. Because this is very difficult without delicate moisture controlling apparatus, there were, no doubt, slight variations. It is hard to believe, however, that variations which were possible under these conditions could exert a striking influence on spore development. The inoculations were performed during the rainy season when atmospheric moisture is at a maximum and temperature fluctuations are at a minimum.

CROSS INOCULATIONS

When plants were inoculated with pure cultures of *C. lussoniensis, C. manihotis,* and *C. melongenae,* conidia were produced from each fungus which were so similar that separation by means of measurements or other physical appearances was impossible. This constancy was true of each specific host only. Variations on different hosts were more or less parallel for all of the fungi.

It was also found that parasitism of the organisms was not confined to any particular family or group of plants. This appears striking on consulting the list of plants given above, all of which were readily parasitized by *C. lussoniensis.*

CONCLUSIONS

From the work which has been completed it appears that morphological differences, unless exceedingly pronounced, are of little value as taxonomic criteria. The host reaction, also, seems to lose its usefulness in separating causal organisms, for the appearance of lesions may be the result of a host function which is caused or stimulated by various and sundry irritants. The type of the leaf rather than the type of the irri-

tation appears to be the factor determining host reaction.

The only valuable taxonomic criteria which have presented themselves for use in separating various species of Cercospora are physiological behavior on artificial media and extent of parasitism.

COLIN G. WELLES

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THE AMERICAN MATHEMATICAL SOCIETY

THE twentieth western meeting of the American Mathematical Society was held at the University of Cincinnati on Friday and Saturday, December 28 and 29, in conjunction with the seventy-fifth meeting of the American Association for the Advancement of Science. The total attendance at these meetings was about 100, among whom were 78 members of the society.

On Friday afternoon, December 28, there was a joint session with Section A of the American Association for the Advancement of Science and the Mathematical Association of America, under the chairmanship of Professor Harris Hancock, Chairman of Section A. The program of this session consisted of the following papers:

American mathematics during three quarters of a century: G. A. MILLER, Retiring Chairman of Section A.

On the equation of the eighth degree: A. B. COBLE, Retiring Chairman of the Chicago Section of the Society.

Arithmetics and their algebras: L. E. DICKSON.

The sessions of Friday forenoon, Saturday forenoon and afternoon were presided over by Professor Oswald Veblen, president of the American Mathematical Society, relieved by Professors R. L. Moore, A. B. Coble and R. C. Archibald. The following papers were read at these meetings:

Theory of construction of group generators as substitutions: W. E. EDINGTON.

On the summability of the triple Fourier's series at points of discontinuity of the function involved: BESS M. EVERSULL.

On a general theorem regarding divergent series, and its application to the double Fourier's series: GAYLORD M. MERRIMAN.

On necessary and sufficient conditions for convergence factors in double series: CHARLES N. MOORE.

Note on the map coloring problem: C. N. REYNOLDS, JR.

Concerning the prime parts of a continuum which separates its plane: R. L. MOORE.

Integral solutions of the Diophantine equations $\xi_1^2 + \xi_2^2 + \cdots + \xi_n^2 = \eta_1^2 + \eta_2^2 + \cdots + \eta_n^2$ *in the quadratic realm of rationality:* WM. KRAUPNER.

On algebraic equations whose roots are trigonometric functions: HARRIS HANCOCK.

Properties of abstract sets implied by properties of the class of all continuous functions: E. W. CHITTENDEN.

The classification of linear families of conics in various domains: ALAN D. CAMPBELL.

The isoperimetric problem with variable end points: MARY E. SINCLAIR.

The hanging chain with end points variable on curves in a plane: MARY E. SINCLAIR.

Covariants of differential forms of arbitrary order and degree: C. C. MACDUFFEE.

Number of cycles of the same order in any substitution group: G. A. MILLER.

Note on linear differential equations with constant coefficients: I. A. BARNETT.

Deflection of a rectangular plate clamped at its edges: H. W. MARCH.

A generalization of the Dirichlet problem: NORBERT WIENER.

On Brouwer's contributions to the foundations of mathematics: ARNOLD DRESDEN.

On the application of the theory of ideals to Diophantine equations: G. E. WAHLIN.

J. H. Rahn's mathematical symbols: FLORIAN CAJORI.

A generalized problem in weighted approximation: DUNHAM JACKSON.

On the zeros of polynomials: E. B. VAN VLECK.

On the Weddle surface and analogous loci: ARNOLD EMCH.

Note on Dirichlet and factorial series: TOMLINSON FORT.

On the dispersion sets of a connected point set: R. L. WILDER.

The theory of closure of Tchebychef's polynomials for an infinite interval: J. A. SHOHAT.

On curves whose first polars contain a pencil of lines: CHAS. H. SISAM.

Integral equations as differential equations of infinite order: H. T. DAVIS.

On the theory of numbers and generalized quaternions: L. E. DICKSON.

Quadratic fields in which factorization is always unique: L. E. DICKSON.

Geometric interpretation of the expression of an algebraic form as a determinant: A. B. COBLE.

Sets of three consecutive integers which are quadratic or cubic residues of primes: H. S. VANDIVER.

On Kummer's Memoir of 1857 concerning Fermat's last theorem: H. S. VANDIVER.

Necessary and sufficient conditions for the existence of a class of Stieltjes integrals: H. L. SMITH.

On polyhedra in Euclidean n-space: S. LEFSCHETZ.

An extension of the theorem that no perfect set is countable: R. L. MOORE.

Note on the integral theorems of vector analysis: LOUIS BRAND.

The Kurschak field of complex numbers: I. M. SCHOTTENFELS.

The error in Hartog's proof of the Zermelo theorem: I. M. SCHOTTENFELS.

ARNOLD DRESDEN,
Assistant Secretary