keit von Najarohgift höchstens um den vierten Teil zurückgeht[1].

Vor einiger Zeit wurde sehr klar gezeigt, dass im *Najarohgift* drei Arten –S–S–Brücken verschiedener Reaktionsfähigkeit existieren. Lässt man Kaliumzyanidlösungen verschiedener Konzentration auf das Gift verschieden lange einwirken, fällt das Protein mit Ammoniumsulfat, zentrifugiert und wäscht es, dann wird es in wechselndem Grade inaktiv, und entsprechend gross ist die nachzuweisende Menge der freien Thiolgruppen[2] (Abb. 12).

Die Stärke der Nitroprussidreaktion – in Abbildung 12 durch +, ++, +++ angegeben – zeigt qualitativ und die Menge verbrauchten Jods quantitativ die Zunahme der entstandenen Thiolgruppen an. Man kann deutlich drei Stufen der Schädigung des Giftes nach vierstündiger Einwirkung des Zyanids unterscheiden. Die erste liegt bei Gift, das mit 0,5prozentiger Kaliumzyanidlösung behandelt wurde. Es verbraucht dann je 25 mg 1 cm³ *n*/500 Jodlösung und hat einen 50prozentigen Aktivitätsverlust erlitten. Mit einprozentiger Zyanidlösung behandelt, ist das Gift nur noch 10% so wirksam und verbraucht 2 cm³ Jodlösung. Drei- und höherprozentiges Kaliumzyanid macht es nach der gleichen Zeit vollkommen unwirksam, und es werden 3 cm³ Jodlösung verbraucht.

Nun ist, wie schon ausgeführt, die Molekelgewichtsbestimmung eines solchen Polypeptids wie des Najaneurotoxins nicht genau durchführbar, aber nimmt man als einen sehr wahrscheinlichen Wert dafür 3500 an und zieht die vorliegenden Schwefel- und Zystinanalysen in Betracht, so ergibt sich aus allen diesen Versuchen, dass das Molekül dieses Toxins drei –S–S–Brücken enthält. Man kann sich vorstellen, dass durch die Zyanideinwirkung zuerst eine, dann die zweite und schliesslich die dritte dieser Brücken gesprengt und das Molekül entsprechend immer unwirksamer wird.

Die nähere Untersuchung der Thiol- und –S–S–Gruppen in den Schlangengiften und anderen Proteinen im Zusammenhange mit deren physiologischen Wirkungen ist jedenfalls eines der grundlegenden Probleme der Biochemie.

[1] F. MICHEEL und H. SCHMITZ, Ber. dtsch. chem. Ges. *71*, 703 (1938).

[2] G. WELLERS, Rev. canad. Biol. *8*, 139 (1949).

Summary

The different snake venoms are mixtures of a large number of physiologically active proteins. So far only the venoms of the Indian cobra (*Naja naja*) and the Bazilian rattlesnake (*Crotalus t. t.*) have been investigated. The hemolytically active component of the *Naja* venom is a protein of molecular weight 33,000, which in the electrophoretic experiment moves together with the neurotoxically active principle. It was possible to separate the two substances by chemical and physical-chemical methods, to crystallize hemolysin and to purify neurotoxin to a large degree. It proved to be a strongly basic, sulphur containing polypeptid.

Rattlesnake venom contains a similar compound of a globulin character which possesses all of the hemolytic and neurotoxic activity of the crude venom. It was crystallized, named «Crotoxin» and further investigated. It is a homogeneous molecule of molecular weight 30,000, which is probably also constituted by basic polypeptid-residues and a protein. Crotoxin is composed of 18 amino acids and is much more sensitive to chemical influences than other physiologically active proteins.

The coagulating and proteolytic activities particularly characteristic of the viper venoms (Russelviper, *Bothrops* sp., *Crotalus t.t.*) always appear together and are liable to be qualities of another protein.

The great virulence of those protein molecules probably depends on the presence of cystin- or cystein-residues, and on their position within the molecule.

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The Content of Certain Spherical Polyhedra for any Number of Dimensions

Consider in Euclidean n-space the set of points $(z_1, z_2, \ldots, z_n)$ satisfying

$$\left.\begin{aligned} &\sum_{k=1}^{n} z_k^2 = 1\,, \quad \text{and} \quad \sum_{k=1}^{n} b_{ik}\, z_k \geqq 0 \qquad (i = 1, \ldots, n) \\ &\text{[the } n \text{ polynomials } \sum_{k=1}^{n} b_{ik}\, z_k \ (i = 1, \ldots, n) \text{ being linearly independent]}. \end{aligned}\right\} \quad (1)$$

Let the numbers c_{ij} be defined by

$$c_{ij} = \sum_{k=1}^{n} b_{ik}\, b_{jk} \quad (i = 1, \ldots, n;\ j = 1, \ldots, n). \tag{2}$$

If, for $i = 1, \ldots, n$ and $j = 1, \ldots, n$,

$$\left.\begin{array}{ll} c_{ij} = 1 & \text{if } i - j = 0 \\ |c_{ij}| < 1 & \text{if } |i - j| = 1 \\ c_{ij} = 0 & \text{if } |i - j| \geqq 2 \end{array}\right\}, \tag{3}$$

then the $(n-1)$-dimensional content of the point set defined by (1) is given by

$$\left.\begin{array}{l} (\pi/2)^m \cdot \prod_{k=1}^{m-1} (n - 2k)^{-1} \cdot \sum_{s=0}^{m} (2/\pi)^s \cdot I_s, \text{ where} \\ m = [\tfrac{1}{2} n],\ I_0 = 1, \text{ and for } 0 < s \leqq m \\ I_s = \sum_{i_1, i_2, \ldots, i_s} \underbrace{\int_0 \cdots \int_0}_{s}^{c_{i_1 j_1}} \cdots \int^{c_{i_s j_s}} \\ \left(D^{i_1 j_1 i_2 j_2 \ldots i_s j_s}_{i_1 j_1 i_2 j_2 \ldots i_s j_s}\right)^{-\frac{1}{2}} d\gamma_{i_1 j_1} d\gamma_{i_2 j_2} \ldots d\gamma_{i_s j_s} \end{array}\right\} \tag{4}$$

In the sum defining I_s (for $0 < s \leqq m$):

(a) $j_p = i_p + 1$ $(p = 1, \ldots, s)$,

(b) $i_1, i_2, \ldots, i_s$ is any set of s integers with $i_1 < i_2 < \ldots < i_s$ chosen from the whole numbers 1 up to $(n-1)$ inclusive in such a way that for each pair (i_p, i_q) of integers in the set the inequality $|i_p - i_q| \geqq 2$ holds good,

(c) summation is over all sets $i_1, i_2, \ldots, i_q$ satisfying this description,

(d) $D^{i_1 j_1 i_2 j_2 \ldots i_s j_s}_{i_1 j_1 i_2 j_2 \ldots i_s j_s}$ stands for the determinant of the $2s \times 2s$ square symmetrical matrix $\|e_{gh}\|$ in which the elements e_{gh} (g and h running, each of them, through $i_1, j_1, i_2, j_2, \ldots, i_s, j_s$) are given by

$$\left.\begin{array}{l} e_{gh} = \gamma_{gh} \text{ if } g = i_p \text{ and } h = j_p = i_p + 1 \ (p = 1, \ldots, s), \\ \text{and} \\ e_{gh} = c_{gh} \text{ otherwise } [c_{gh} \text{ was defined in (3)}]. \end{array}\right\}$$

If in (1) $\sum_{k=1}^{n} z_k^2 = 1$ is replaced by $\sum_{k=1}^{n} z_k^2 \leqq 1$, the result (4) is to be multiplied by $1/n$, of course.

The $(n-1)$-dimensional content of the point set defined by (1) occurred in a problem in statistics[1]. It had been investigated, however, as early as 1852 by SCHLÄFLI[2] who gave a number of theorems on it, but nothing like a general result by which this content should be explicitly determined. COXETER[3] gave a rather complicated series development for the content of orthoschemes (see below) in case $n = 4$; there is no hint at our result (4) in his paper; moreover, (4) holds with any (integer) value of n $(\geqq 2)$.

If $c_{ij} = 0$ for each pair (i, j) with $|i - j| \geqq 2$ $(i = 1, \ldots, n;\ j = 1, \ldots, n)$, the point set defined by (1) is called an n-spherical orthoscheme by SCHLÄFLI[1] (l.c., p. 74); if this equality does not hold true for each pair (i, j) with $|i - j| \geqq 2$, the point set defined by (1) is called an n-spherical plagioscheme by SCHLÄFLI (l.c., p. 58); I would prefer the terms $(n-1)$-dimensional spherical orthoscheme, and plagioscheme, respectively. The result (4) obtains for orthoschemes only. Research on plagioschemes is in progress, as is research on the expansion of I_s in a particular, relatively simple, multiple series.

The result (4) can be proved by two widely different methods, one of them being a straightforward solution of the system of linear partial differential equations of the first order given by SCHLÄFLI[1] (l.c., p. 65). Both methods are somewhat lengthy, but fairly elementary.

H. R. VAN DER VAART

Zoological Laboratory of University, Leiden, November 22, 1952.

Zusammenfassung

In kurzer Form wird der Inhalt gewisser (orthoschematischer) sphärischer Polyeder für eine willkürliche Dimensionenzahl mitgeteilt. Diese Formel bildet die Lösung eines von SCHLÄFLI aufgestellten Systems linearer partieller Differentialgleichungen erster Ordnung.

[1] H. R. VAN DER VAART, Proc. Kon. Ned. Akad. Wet. *53*, 494, 507 (1950); Indagationes Mathematicae *12*, 146, 159 (1950).

[2] J. H. GRAF, Mitt. Bern. Naturfor. Ges. *1896*, 77. – L. SCHLÄFLI (hg. v. J. H. GRAF), *Neue Denkschriften der allgemeinen schweizerischen Gesellschaft für die gesamten Naturwissenschaften*, Bd. *38* (1901), IV und 239 S.

[3] H. S. M. COXETER, Quart. J. Math., Oxf. Ser. *6*, 13 (1935).

[1] L. SCHLÄFLI (hg. v. J. H. GRAF), *Neue Denkschriften der allgemeinen schweizerischen Gesellschaft für die gesamten Naturwissenschaften*, Bd. *38* (1901), IV u. 239 S.

Notes on the Alkaloids of *Picralima*

The alkaloids of *Picralima nitida* occur in the seeds and have been studied by HENRY and SHARP[1] and HENRY[2], as well as by RAYMOND-HAMET[3] who has given a review of the subject[4].

Akuammine[5].—The formula attributed to the base by HENRY and SHARP[1] was $C_{22}H_{28}O_4N_2$, but the results did not exclude $C_{22}H_{26}O_4N_2$. 16 analyses of 12 different specimens (all decomposing at 254–259°) gave as average C, 69·02; H, 6·88%. 10 results within ±0·3% of the mean gave C, 68·98%, and 13 results within ±0·1% of the mean gave H, 6·88%. The average of 6 results gave N, 7·18%. $C_{22}H_{26}O_4N_2$ requires C, 69·09; H, 6·85; N, 7·33%. $C_{22}H_{28}O_4N_2$ requires C, 68·73; H, 7·34; N, 7·29%. The formula with H_{26} is evidently preferable.

The groups known to be present are 1 OMe, 1 NMe, 1 OH which we have confirmed. 1 CMe is also present (found, Me, 2·89%). Akuammine is a strong base, pK_a, 7·5 (strychnine, 7·6) and electrometric titration with alkali gave a curve with no inflection up to pH 10. This

[1] T. A. HENRY and T. M. SHARP, J. Chem. Soc. *1927* (1950).

[2] T. A. HENRY, J. Chem. Soc. *1932*, 2759.

[3] M. RAYMOND-HAMET, C. r. Acad. Sci. *211*, 125 (1940); Arch. exp. Path. Pharm. *199*, 399 (1942); C. r. Soc. Biol. *137*, 404 (1943); *138*, 199 (1944); C. r. Acad. Sci. *221*, 699 (1945); *230*, 1183 (1950); Rev. Int. bot. app. Agric. trop. *31*, 465 (1951); C. r. Acad. Sci. *233*, 560 (1951).

[4] M. RAYMOND-HAMET, Rev. Int. bot. app. Agric. trop. *31*, 465 (1951).

[5] The initiation of the present investigation was the result of the good offices of Professor E. SCHLITTLER who put us in touch with Dr. A. UFFER of Ciba, Ltd. Dr. UFFER separated the alkaloidal content of seeds of *Picralima nitida* collected in Kumasi (August, 1947) and very kindly sent us substantial quantities of akuammine and fractions obtained in the course of his work. We are also deeply indebted to Dr. T. M. SHARP of the Wellcome Research Laboratories for specimens of akuammine and some of its congeners. The akuammine was derived from *Picralima Klaineana* and was found by comparison of I. R. spectra to be identical with that from *Picralima nitida*.