the velocity of gravitation would have to be extremely large. He argues that otherwise Mercury would leave the solar system in about 300 years from now, and that, if the velocity is so large, the advance of perihelion would be negligible. Now Laplace and Tisserand could not assume a resisting medium because their equations led to a retardation, and a resisting medium would have made things worse. But in my theory the resisting medium, through which the planets move, acts tangentially in the opposite direction, counteracts the tangential acceleration and, while producing a null effect on the advance of the perihelion, reduces the dreaded perturbations!

Admittedly, the sign predicted by my formula, in the case of the eccentricity of Venus, the earth and Mars, agrees with Newcomb's observations.[5] In the case of Mercury, which passes closer to the sun, the retardation just overcomes the acceleration, and the discrepancy changes sign. In the case of Encke's comet, which passes closer still, the resistance is so great that it actually causes a marked shortening of the period!

It is, therefore, rather premature to jump to the conclusion that my theory will, of a necessity, founder ultimately on this yet untouched rock. The only phenomenon which can be exactly observed because of accurate photography is the deflection of light from a star passing close to the sun. My result, which accords fairly closely with the present known values, differs widely from that obtained from the generalized principle of relativity. The next solar eclipse on June 8, 1937, in Peru will furnish the final test. In the meantime, Chapters III, IV and V, dealing with the "Expanding Universe" and "Special Relativity," have also been published, though owing to the length of the paper the last sections relating to experiments are unfortunately not full. Criticisms thereon would be welcome.

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IN the above defense of his "theory of a new relativity," Sir Shah Sulaiman does not deny the main point of the author's original criticism, namely, that the new theory in its published form predicts a yearly secular logarithmic perturbation of Mercury's eccentricity of the order of $+1.3\times10^{-2}$, whereas that observed is -4×10^{-8}; and while the point is made that the signs of predicted and observed perturbations agree for Venus, the earth and Mars, it should be remembered that the predicted values range from 6×10^{4} to 2×10^{6} times the observed changes of the eccentricity.

The statement is made that "the resisting medium, through which the planets move, acts tangentially in the opposite direction, counteracts the tangential acceleration and, while producing a null effect on the advance of the perihelion, reduces the dreaded perturbations"! Also, "only a few solutions by successive approximations, by omitting higher powers, have been published by me." The inference is that an attempt is to be made to modify the present results by the consideration of higher order terms and the introduction of a resisting medium (which has not been considered in the two papers thus far published). However, as regards higher order terms, the author has found since the publication of his original comments on Sulaiman's theory that a consideration of *all* terms of order $1/D^2$, which were introduced by Sulaiman himself (D being the velocity of propagation of gravitation, assumed equal to the velocity of light), several of which were subsequently neglected by Sulaiman, converts the previously obtained correct advance of the perihelion to an actual retrogression, in absolute magnitude one sixth the previously predicted advance; but the perturbations of the eccentricity and semi-major axis remain unaltered. An *ad hoc* resisting medium may cancel out the latter undesired perturbations, but as Sulaiman points out above, it can have no secular effect on the longitude of perihelion.[1] Prediction of the proper perihelion advance was supposedly one of the strongest points in support of the new theory.

The details of these corrections to Sulaiman's theory, as well as a complete account of the numerical perturbations predicted by Sulaiman's formulae, are to be published shortly.

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THE NEW ERGOT ALKALOID

H. W. DUDLEY and C. Moir,[1] M. S. Kharasch and R. R. Legault,[2] M. R. Thompson[3] and W. A. Jacobs and L. C. Craig[4] have published in this journal their investigations on new physiologically interesting substances isolated from ergot of rye. Since Sir Henry Dale[5] has continued the discussion by means of a brief on the question of priority and especially on the naming of the new ergot alkaloid, I take this opportunity to inform the readers of SCIENCE of the isolation of "Ergobasine," its characteristics and the reasons for selecting this particular name. The report of H. H. Dale will be supplemented from the chemical

[5] Tisserand, "Mécanique Celeste," Vol. 4: 535.

[1] H. C. Plummer, "Dynamical Astronomy," pp. 177–179.

[1] SCIENCE, Supplement, p. 10, March 29, 1935, and 81: 559, 1935.

[2] SCIENCE, 81: 388 and 614, 1935.

[3] SCIENCE, 81: 636, 1935.

[4] SCIENCE, 82: 16, 1935.

[5] SCIENCE, 82: 99, 1935.

standpoint and an effort will also be made to clarify the question of identity of the different preparations.

The investigations of C. Moir[6] and M. R. Thompson[7] in 1932 gave indications of the existence of a then unknown active substance in ergot of rye, which by oral administration caused a quicker contracting action on the uterus than the alkaloids of the ergotoxine-ergotamine group. In our laboratories there were performed chemical, pharmacological and clinical investigations, to confirm the findings of C. Moir. The ergot of rye used for this purpose yielded a fair amount of ergotamine. The result of our investigations showed that the extracts had lost their activity on the human and animal uterus as soon as the alkaloids of the ergotamine-ergotoxine group had been removed. This proves the existence of certain kinds of ergot of rye which do not contain the new alkaloid.

Though we could not confirm the observations of C. Moir with our ergot of rye we continued the chemical analysis of ergot. When we changed the material for the production of alkaloids (ergotamine, ergotoxine) and employed Spanish ergot of rye, we discovered, at the beginning of this year, an alkaloid with unknown properties. This new alkaloid was isolated by purely chemical methods without resort to pharmacological or clinical tests. Because it differed in some important properties from the substances described in the literature, we suggested the new name "Ergobasine," due to its water solubility and relatively strong basic reaction in aqueous solution.

Meanwhile the publications of American and English investigators had appeared, describing the new active principle which with assistance of physiological tests had been isolated in a more or less pure form. As the work of these authors was essentially of a physiological nature and somewhat less chemically directed, there arose the names "Ergometrine," "Ergotocin," "Ergostetrine," all related to the action of the substance.

As long as a substance is not presented in a pure form and one does not know exactly its essential properties, it is quite natural to refer to its action in choosing a name. But such names might become unsuitable when new important therapeutic indications are discovered that differ from the first found characteristic actions. The Council on Pharmacy and Chemistry of the American Medical Association generally disapproves of names in which therapeutic indications are suggested and prefers terms based on the chemical nature or on the origin of a substance (Adrenalin, Insulin, etc.). "Ergobasine" indicates the origin and an important chemical property of the substance.

[6] *Brit. Med. Jour.*, No. 3728, p. 1119, 1932.
[7] *Jour. Am. Pharm. Assoc.*, 21: 853, 1932, and continuation.

In judging the claim of priority for the first isolation of a substance, the chemist requires more severe criteria than the pharmacologist. He expects a substance to be prepared in pure form, so that it may be characterized by important physical constants, by a complete analysis and an empirical formula derived thereof. We withheld our first publication until we were able to furnish all these data for the meeting of the Académie des Sciences in Paris, on May 13.[8] In the *Bulletin des Sciences Pharmacologiques,* May, 1935,[9] are published all the facts concerning the exact chemical and physical characteristics of pure ergobasine. Photographs of crystals of the pure base, from benzol and dichlorethylene, and of its hydrochloride, its sulfate, its tartrate and its picrate are also included in the paper. At that time comparable data on ergotocin and ergostetrine were completely missing and the physical and chemical findings by W. H. Dudley and C. Moir[10] differed on important points so greatly from our data, which had been determined with the pure substance, that we considered ergobasine to be a new alkaloid, different from ergometrine.

The English authors with ergometrine in 0.1 per cent. chloroform solution found a specific optical rotation $[\alpha]\ D = -45°$, whereas we did not at all succeed in preparing a sufficiently concentrated solution of ergobasine in chloroform to make such a polariscopic reading because our alkaloid is almost insoluble in chloroform. The 0.25 per cent. aqueous solution of ergobasine, however, showed $[\alpha]_D^{20} = +90°$.

The measuring of the rotation of ergobasine in ethyl alcohol and mixtures with chloroform gave the following values:

$[\alpha]_D^{20} = +42$ (c = 0.8 in ethyl alcohol)

$[\alpha]_D^{20} = +44$ (c = 0.8 in 70 chloroform + 30 alcohol)

$[\alpha]_D^{20} = +36$ (c = 0.4 in 85 chloroform + 15 alcohol)

$[\alpha]_D^{20} = +23$ (c = 0.2 in 92.5 chloroform + 7.5 alcohol)

This demonstrates that we did not succeed in preparing a solution of our ergobasine preparation in pure chloroform, but our measurements seem to indicate, in comparison with the data of H. W. Dudley and C. Moir, that the English authors had a preparation which was contaminated with a strongly levorotatory substance. The impurity might have caused the solubility of their preparations in chloroform.

[8] C. R. Ac. Sc., 200: 1680, 1935.
[9] *Bull. Sc. Pharmacol.*, 42: 257, 1935.
[10] *Brit. Med. Jour.*, 3871, 520, 1935.

The values for the elementary analysis (C=71.46; H=7.38; N=11.66 per cent.) communicated by the English investigators in March, 1935,[11] as they say with reservation, differ so much from the theory of our ergobasine formula $C_{19}H_{23}O_2N_3$ (C=70.11; H=7.13; N=12.92 per cent.) that every chemist must conclude that Dudley and Moir analyzed either another or an impure substance.

H. H. Dale seems to have overlooked that in the report on Ergobasine, under the chapter, "Préparation de l'Ergobasine"[12] two methods for preparing ergobasine are given, which are based on the very slight solubility of the alkaloid in chloroform and its good solubility in water. These properties made possible the separation of ergobasine from the alkaloids of the ergotamine-ergotoxine group. Since then H. W. Dudley[13] also published a method for the preparation of ergometrine, but even here are missing the analyses of the base and its salts and the exact measurement of the optical rotation which would enable the chemist to identify the prepared substance. Ergometrine is now reported to be dextro-rotatory in ethyl alcohol. Only in a paper presented by C. Moir[14] we find the statement that ergometrine has, according to the investigation of H. W. Dudley, the formula $C_{19}H_{23}O_2N_3$, which is the same as we have found for ergobasine.

The data published so far on the identity of the substances prepared in different laboratories are briefly as follows:

W. A. Jacobs and L. C. Craig[15] have shown by direct comparison that the substance isolated by them from ergot of rye is identical with ergobasine. The independent analyses made by these authors confirm the formula $C_{19}H_{23}O_2N_3$ for ergobasine. The successful cleavage to lysergic acid and 2-aminopropanol-1 constitutes additional and valuable evidence for the formula, proving at the same time the connection between ergobasine and the alkaloids of the ergotamine-ergotoxine group.

A sample of 40 mgs ergostetrine, which Professor Thompson kindly sent us a few weeks ago in exchange for ergobasine, showed in crystalline form, water solubility and optical rotation in water ($[\alpha]_D^{20} = +88.5°$) the characteristics of ergobasine. Ergostetrine is therefore in all probability identical with ergobasine.

We have obtained from a trade package of ergometrine, of an English firm, an alkaloid preparation which was not homogeneous, but from which a fair amount of pure ergobasine was isolated.

The analyses reported by M. S. Kharasch and R. R. Legault[16] concerning their substance differ considerably from our ergobasine analyses and led to the formula $C_{21}H_{27}O_3N_3$ for ergotocin. The description of ergotocin as given by these authors differs from the published data on ergobasine, for instance, in the difficulties in salt formation of ergotocin with monobasic acids. Exact and direct comparison is still lacking. We did not fail to place a sufficient quantity of pure ergobasine for comparison purposes at the disposal of all the investigators who desired it.

That ergot of rye contains not only one alkaloid but several with the approximate molecular weight of ergobasine is shown by a recent communication of S. Smith and G. M. Timmis,[17] which describes the isolation of a new ergot alkaloid characterized by its decomposition point at 195°, its salt formation with HNO_3, HBr, and H_2SO_4 and by the very high optical rotation $[\alpha]_{5461}^{20} = +520°$ (c=1 in chloroform). The new substance named ergometrinine, with the formula $C_{19}H_{23}O_2N_3$, proved to be isomeric with ergobasine (ergometrine) and could be transformed into ergometrine. The newly discovered alkaloids seem to be a group of substances like the long known alkaloids of ergot, ergotinine-ergotoxine and ergotamine-ergotaminine, which are similar as a group, but possess different individual characteristics.

Through the exact physiological and chemical comparison of ergotoxine and ergotamine, we know that the chemical identity of substances can not be determined from the similarity of physiological action. For many years ergotoxine and ergotamine were supposed to be pharmacologically identical, and it is only recently that especially E. Rothlin[18] has shown some qualitative differences in the minute pharmacological activity of these alkaloids. Chemically, the difference of the two alkaloids was always evident.

The decision on the question of identity or difference of the newly prepared alkaloidal substances isolated by various investigators can of course only be determined by exact physical and chemical comparison.

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HETEROTHALLISM OF SUNFLOWER POWDERY MILDEW

THE formation of perithecia on only certain areas of diseased leaves and at the intersection of two mildew colonies indicated the likelihood of heterothallism of *Erysiphe cichoracearum* D.C. on sunflower, *Helianthus annuus* L. The formation of perithecia on young excised leaves floating on 5 per cent. sucrose solution

[11] *Brit. Med. Jour.*, No. 3871, p. 521, 1935.
[12] *Bull. Sci. Pharmacol.*, 42: 259, 1935.
[13] *The Pharmaceutical Journal*, June 15, 1935.
[14] *Brit. Med. Jour.*, No. 3890, p. 178, July 27, 1935.
[15] SCIENCE, 82: 16, 1935.
[16] *Jour. Am. Chem. Soc.*, 57: 956 and 1140, 1935.
[17] *Nature*, August 17, 1935, p. 295.
[18] E. Rothlin, *Archivio di Scienze Biologiche*, 18: 1–4, 1933, and *Klin. Wsch.*, 12: 25, 1933.