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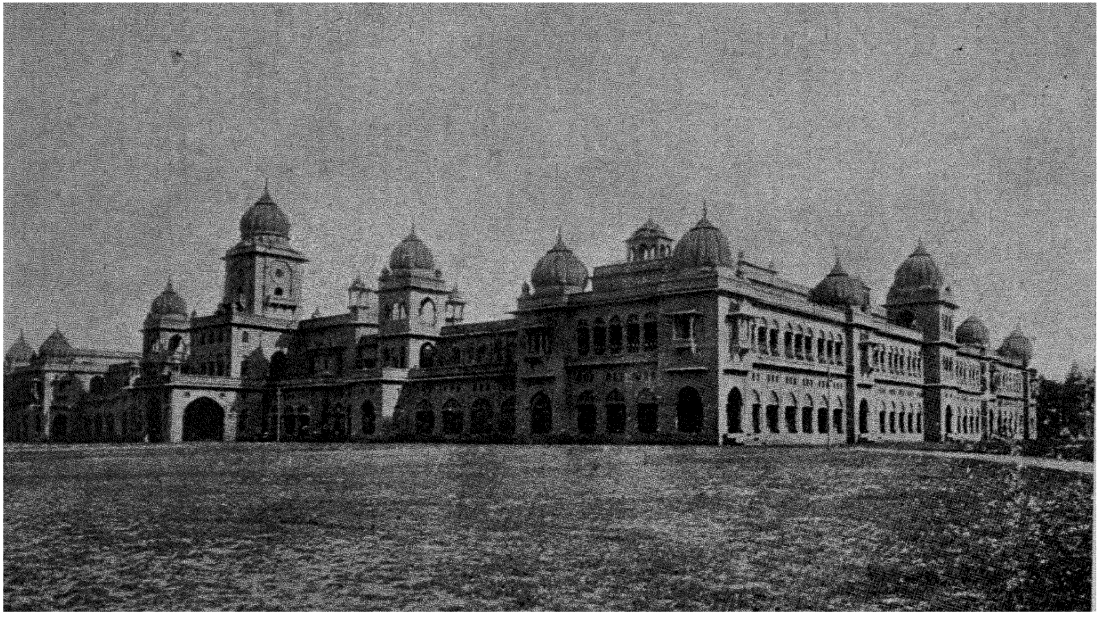
MEMBERS OF THE UNIVERSITY

1928—1932



PUBLISHED BY ORDER OF THE EXECUTIVE COUNCIL

1933.



CANNING COLLEGE, LUCKNOW UNIVERSITY.

PREFACE

1. According to the directions of the Executive Council, that a detailed statement of the research work done in the University should be published every five years, Dr. Cameron the then Vice-Chancellor, published the first Quinquennial Report in 1928. The present is the second report of the same nature. It contains suitable abstracts of original papers contributed to journals and learned societies as also books published by the members of the staff.

2. The report has been arranged in sections corresponding to the various Faculties of Arts, Science, Medicine, and Commerce, and at the beginning of each section has been placed a list of the members of the staff belonging to the Faculty. It also includes reference to the work of post-graduate students.

3. The Report gives a useful conspectus of the work that is being done in the various departments of the University in addition to the regular lectures and tuition work.

4. To workers elsewhere, too, who are facing the same or similar aspects of the various subjects dealt with, it is not impossible that these abstracts may have a peculiar interest as indicating not only that their special problems are being attempted here but also the lines on which the work is being carried on and what kind of results are being reached.

5. With the abstracts are given references to journals, society proceedings or publishers, to facilitate consultation of the full and detailed records of the special work done.

6. It will be seen that a good deal of valuable work has been done in the various departments of the University. The resources of the University both in *personnel* and finance are limited ; and there is every reason to hope that if more facilities are available a good deal of more work will be turned out by the University.

R. P. PARANJPYE,
Vice-Chancellor.

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UNIVERSITY OF LUCKNOW

FACULTY OF ARTS.

Teaching Staff.

English—

1. N. K. Sidhanta Esq., M.A. (Cal.), M.A. (Cantab.), Professor.
2. L. R. M. Brander Esq , M.A. (Edin.), Reader.
3. Miss Nora Roy, M.A. (Luck.), Reader.
4. Dr. A. Vittal Rao, M.A. (Madras), PH.D. (Lond.), Bar-at-Law, Temporary Lecturer.
5. F. T. Roy Esq., M.A. (Alld.), Lecturer.
6. R. R. Sreshta Esq., M.A., LL.B (Cantab.), Lecturer.
7. C. G. Roy Esq., M.A. (Alld.), Lecturer.
8. A. T. Bhattacharya Esq., M.A. (Luck.), Junior Lecturer.
9. Syed Ameer Ali Esq., M.A., B L. (Cal.), Junior Lecturer.
10. Dayamoy Mitra Esq. M.A. (Luck.), Junior Lecturer.
11. Dr. (Miss) E. C. Tucker, PH.D. (Yale), Teacher.

Philosophy—

1. Dr. N. N. Sen Gupta, M.A., PH.D. (Harvard), Professor.
2. E. Ahmad Shah Esq., M.A. (Alld.), B.I ITT., Dip. in Ed. (Oxon.), M.L.C., Reader.
3. Kali Prasad Esq., M.A. (Alld.), Lecturer.
4. Miss B. Venkataratnam, M.A. (Madras), Teacher.

European History—

1. S. B. Smith Esq., M.A. (Oxon.), Professor.
2. S. N Das Gupta Esq., M.A. (Lond.), Lecturer.
3. Mrs. L. Menon, M.A. (Madras), Teacher.

Indian History—

1. Dr. Radha Kumud Mookerji, M.A., PH.D. (Cal.), Vidyavaibhava Sir Sayaji Rao Gaekwad Prizeman, Itihasa-Siromani (Baroda), Premchand Roychand Scholar, Professor.
2. Dr. Sukumar Banerji, M.A., L T. (Alld.), PH.D. (Lond.), Reader.
3. Charan Das Chatterji Esq., M.A. (Cal.), Lecturer.
4. Nanda Lal Chatterji Esq., M.A. (Alld.), Lecturer.
5. Miss S. Chakko, M.A. (Madras), Teacher.

Political Science—

1. Dr. V. S. Ram, B.A. (HONS.) (California), M.A., PH.D. (Harvard), F.R.H.S., Reader.
2. Miss R. C. Manchester, M.A. (Bryn. Maur.), Reader.
3. V. K. Nandan Menon Esq., B.A. (HONS.) (Madras), B.A. (Oxon.), Lecturer.
4. Dr. E. Asirvatham, B.A. (Madras), B.D. (U. S. A.), PH.D. (Edin.), Lecturer.
5. Mohammad Sultan Esq., M.A. (Luck.), Junior Lecturer.

Economics and Sociology—

1. Dr. Radhakamal Mukerjee, M.A., PH.D. (Cal.), Premchand Roychand Scholar, Professor.
2. Bhujanga Bhushan Mukherjee Esq., M.A., B.L. (Cal.), F.E.S., Premchand Roychand Scholar, Reader.
3. Dr. H. L. Dey, M. A. (Cal.), D.SC. (Lond.), Premchand Roychand Scholar, Lecturer.
4. Dhurjati Prasad Mukerji Esq., M.A. (Cal.), Lecturer.
5. D. N. Majumdar Esq., M.A. (Cal.), Premchand Roychand Scholar, Lecturer in Anthropology.
6. Miss Ivy Thomas, M.A. (Michigan), Teacher.

Arabic—

1. Dr. Mohammad Wahid Mirza, M.A. (Panj.), PH.D. (Lond.), Reader.
2. Maulvi Khalil Ibn Mohammad Arab, Lecturer.

Persian and Urdu—

1. Syed Masud Hasan Rizavi, M.A. (Luck.), Reader.
2. Maulana Mohammad Abdul Qavi Fani, M.A. (Alld.), Lecturer.
3. Syed Yusuf Husain Mosvi Esq., M.A. (Luck.), Lecturer.
4. Syed Mohammad Husain Esq., M.A., H.P. (Panj.), Mulla Fazil, M.A., LL.B. (Alld.), Lecturer in Urdu.

Sanskrit, Prakrit Languages, and Hindi —

1. K. A. Subramania Iyer Esq., M.A. (Lond.), Sissendi Raj Reader.
2. Pandit Badri Nath Shastri, M.A. (Alld.), Lecturer.
3. Pandit Adya Datta Thakur M.A. (Alld.), Lecturer.
4. Pandit Badri Nath Bhatt, B.A. (Alld.), Lecturer in Hindi.

Modern European Languages—

K. A. Subramania Iyer Esq., M. A. (Lond.), Lecturer in French.

DEPARTMENT OF ENGLISH.

N. K. Sidhanta.

(*a*) *Book :*

The Heroic Age of India : A Comparative Study : (Kegan Paul, " The History of Civilisation " Series, 1929).

The book examines Heroic Poetry composed in various parts of Europe and India and analyses the common characteristics of such poems, the resemblances being evident both in style and in the social background. The " Great Epic " of India is examined in detail and the heroic and religious elements in it are sought to be separated. The different sections of the book deal with Society, Government and Religion in the Indian Heroic Age and concludes that the conditions requisite for a Heroic Age are " Mars and the Muses " and the conflict represented is usually of an inferior type of civilisation with a superior one.

(*b*) *Articles :*

(1) *Thomas Hardy :* (The Modern Review, February, 1928).

An attempt to estimate the value of Hardy's work in relation to the late Victorian Era.

(2) *The Anglo-Saxon Settlement in Britain :* (Madan Mohan Malaviya Commemoration Volume).

The usually accepted theory about the settlement of the Angles, Saxons and Jutes is examined from various points of view and it is concluded that while there appears to be a distinction between the " Jutes " and the Anglo-Saxons, there is very little ground for distinguishing Angles from Saxons.

(3) *Indian Painting :* (The Rupa-Lekha, 1929).

A note on the characteristics of Indian painting before the Mahomedan conquest, in the Mughal Era and in the last two Centuries.

A. Vittal Rao.

Article :

The Teaching of English in the Indian Universities : (The 'Hindu' Educational and Literary Supplement, December, 1932).

DEPARTMENT OF PHILOSOPHY.

N. N. Sen Gupta.

Articles :

(1) *Studies in Involuntary Movement.* (Indian Journal of Psychology, January, 1927, 10 pp.).

It presents the data of a series of experiments performed by the author for determining the frequency and amplitude of tremors of normal individuals when the hand is at rest. The effect of change of angle of the hand, influence of sensory stimulus upon the tremors, as also variations in frequency on different dates, have been recorded with the help of an appliance specially devised for the purpose.

(2) *On Gestalt Theory :* (Indian Journal of Psychology, April 1927, 15 pp , also Proc. Indian Science Congress, 1927).

The paper traces the history of the Gestalt Theory from its early beginnings in the experiments of Wertheimer in 1912 and from the earlier Gestalt conception, found in the writings of of Meinong and Ehrenfels. It shows the lines on which the theory was later elaborated by Koffka, Köhler and others.

(3) *Field of Race-Psychology:* (Indian Journal of Psychology, Vol. III, No. 2, 1928, 10 pp.).

The paper surveys the different lines of work done in the field of Race-Psychology, and attempts to define it in more precise terms.

(4) *Nature of Attention:* (Indian Journal of Psychology, 1928, 10 pp.).

The paper surveys the structural and functional theories of Attention and shows the difficulties in interpreting the experimental data on which the former is based. It puts forward a suggestion for developing a theory in terms of duration.

(5) *A Note on Contemporary Sensationalism:* (Philosophical Quarterly, July 1921, 9 pp.).

It is an analysis of the concept of sensation as found in contemporary epistemology. It shows how the conception derives its plausibility from a mystic connotation of the term.

(6) *Psychological Explanation:* (Proc. Indian Philosophical Congress, 1928, 5 pp.).

Different explanatory principles are employed in the present-day Psychology and constitute the basic difference between the different schools. The paper suggests that explanation in Psychology consists, as is shown by an analysis of the actual procedure, in correlating the psychological data with four variable factors: (i) antecedent psychosis, (ii) physiological factors, peripheral and central, (iii) social stimuli, and (iv) physical stimuli.

(7) *Monocular Perception of Distance*—(joint paper with **S. K. Bose**) : (Indian Journal of Psychology, 1928, 6 pp.).

The paper presents the data of a series of experiments for measuring the amount of error in the estimation of short variable

distances between two vertical lines. An apparatus, specially devised for the purpose, was employed. The liminal values for various distances are obtained and are found to be much smaller, sometimes as small as only 20 per cent of the values obtained in previous experiments.

(8) *On the Nature of Instinct :* (Proc. Indian Philosophical Congress, 1929, 17 pp.).

It is a critical survey of the discussions on the problems of Instinct up to 1925, followed by suggestions for the formulation of a new theory.

(9) *Psychological basis of Personal Identity :* (Philosophical Quarterly, 1931, 8 pp.).

It presents a critical analysis of the psychological theories of Wundt and James, and a survey of the data of abnormal psychology and of experiments bearing on the question. There is an attempt at interpreting the data in terms of the physiological hypothesis formulated by Wertheimer.

(10) *Psychology of Loneliness :* (Philosophical Quarterly, 1931, 9 pp.).

The paper presents an analysis of the facts concerning the influence of isolation on the psychophysical system of the individual. It presents also a number of data obtained by observation. There is an attempt to explain the various types facts in terms of some of the accredited principles of Psychology.

(11) *Introduction to Social Psychology*—(jointly with **Radhakamal Mukerjee**): (American Edition—D. C. Heath & Sons. British Edition—Harrap & Sons).

The book surveys the principal topics of Social Psychology, its methodology, its historical development and its filiation with other branches of Psychology. The special feature consists in a systematic effort at applying the known principles of scientific Psychology to the explanation of the problems of Social Psychology.

E. Ahmad Shah.

Articles :

(1) *Philosophical Reflections on some Implications of the Law of Karma .* (Proc. Indian Philosophical Congress, Bombay, 1928).

The Law of Karma relates to the invisible realm, hence can neither be directly proved nor disproved. But (i) as its rigorous hold is shaken in view of the Law of Transference of Karma ; (ii) as its uninterrupted sway over life is set aside by the Doctrine of Prasada (grace) ; (iii) as it does not give a satisfactory explanation of the origin and continuity of life here and hereafter, in view of Brahma as the origin of subsistence and dissolution of things ; and (iv) as in view of the Law of Heredity, it is largely rendered unnecessary, we draw the conclusion that it cannot be expected as a Law satisfactorily explaining the facts of Life.

(2) *An Ethical estimation of the Concept of God in Islam :* (Muslim Review, 1928).

God (Allah) is one—112 : 29 ; 37 : 4 ; 20 : 7. His names—a conceptual attempt to determine his nature through 99 terms.

The central ethical conception is good. Inasmuch as God is the author of good *and* evil 91 : 8, his nature is not ethically perfect, though metaphysically he may be considered a complete whole, embodying both good and evil.

A most beautiful description of Godhood given in the oft repeated words :

بِاسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ (In the name of God who is kind and merciful).

God as Light, as Perfect, as All-Powerful and above all as Gracious and Forgiving.

(3) *Indian Philosophy and Christian Faith*—(A Lecture delivered at Marburg University, Germany): (Hessiscles Tageblatt, 1928).

The nature of man according to the Sankhya and Vedanta points of view ; man's origin according to both the views.

An estimation of the value of existence. The law of existence—the doctrine of Karma. Means of release—the doctrine of Moksha. The nature of Brahman—the goal of release.

According to Hindu Philosophy man is, more or less, a product of unknown conditions ; for the soul, somehow or other, at some point of time forgot itself and was, thus, overcome by Prakriti or Upadhis. According to Christian Faith as we understand it, man is a creature of God. He is created in His image. Creation in His image means creation of man as a free-willed agent, having discerning light of reason, self-determining power of Will and ever seeking and burning love for communion with his Creator.

According to the former view life is an evil in itself, for it indicates the existence of the soul under fettered conditions, whereas according to the latter view, life is not evil in itself, it is evil in life, introduced in life by an act of choice of the free-willed agent, it is this evil which makes life tainted. Consequently the doctrine of Moksha is release from life altogether ; whereas the doctrine of salvation is to combat and overcome evil in life.

The outlook of Hindu Philosophy is, at best, of a wise agnosticism ; whereas that of Christian Faith is that of a 'Faith that enquires.' The goal of the former is absorption in Brahman ; whereas of the latter is that of communion fellowship with God.

(4) *The Doctrine of the Freedom of the Will:* (Philosophical Congress, Lahore, 1930).

Spencer's position—the freedom of the Will is against the universally recognised and acknowledged Law of Causation.

James Ward's vindication of it; meaning of motive; mind as cause—formal and efficient causation.

(Sense of remorse), meaning of obligation, conception of 'ought', sense of duty—all these factors go to suggest the Freedom of the Will.

(5) *Appearance and Reality: An examination of Shankara's position:* (Philosophical Congress, Patna, 1931).

Vedanta, Sutras II. 1. 23—"This entire apparent world, in which good and evil actions are done *is a mere illusion*, owing to the non-discrimination of (the Self's) limiting adjuncts, which spring from name and form, the presentations of Nescience, and does in reality not exist at all".

Shankara's two supports: scriptural and philosophical; examination of these supports. Critical estimation of the position from the point of view of Ramanuja, Max Muller, Dr. Thibaut and Professor Macdonell.

Comparing his (Shankara's) arguments as advanced against other systems, it will not be altogether wrong to maintain that the illusory character of the world is not as conclusively established as it is commonly held.

(6) *Philosophy and Kingdom of God—A course of three lectures:* (Sat Tal Ashram Studies, 1932).

Lecture No. 1.—Speculative Thought and Reality.

Lecture No. 2.—Shankara's Conception of God and the Cosmos.

Lecture No. 3.—Philosophy of Life and Reality.

1.—*Speculative Thought and Reality :*

The goal of philosophy is complete knowledge of things and this can be reached by clear and distinct thinking (*Spinoza*).

Hume accepted Berkeley's criticism of matter (substratum) and, applying the same test of reality, denied the *knowledge* of the existence of self. "The mind is a bundle or collection of sensations" and nothing more. Hence Hume maintained that we cannot *demonstrate* the existence of soul-substance, much less of God.

"Kant's Critique of Pure Reason" clearly points that the understanding can *know* only what can be experienced ; but reason tries to go beyond the confines of the understanding and attempts to conceive the supersensible, that which is merely thought. It confuses percepts with *mere thought* and falls into ambiguities, contradictions and antinomies.

Speculative thought can both prove and disprove the existence of Self and God. (The paralogisms and antinomies of Pure Reason).

Scottish rationalistic philosophy, through Hamilton suggests that we can only *know* the conditionally limited ; existence is not cognizable absolutely and in itself. If this is so we *cannot know* the ultimate being or God.

Result of speculative thought is a thorough-going agnosticism.

2.—*Shankara's Conception of God and the Universe ·*

(*a*) Affirmative conception of Brahman :—

Brahman is eternal purity, Intelligence and Freedom (Vedanta Sutra I. 1-2).

He is from which the origin, subsistence and dissolution of the world proceed (V. S. I. 1-2).

(*b*) Negative Conception :—

He is without cause, without effect, without anything inside or outside. (Brih. Up. II. 5.19).

The self is to be described by No. no. He is incomprehensible, imperishable, unattached. (Brih. Up. III. 9.26).

From the conception of Brahman as Sangrah, we are led to conceive him as Niraguna-Neti,—Neti. (Brih. Up. IV. 2.4; IV. 5.15).

A thorough going agnosticism, or as Sir Radha Krishnan would say, wise agnosticism.

The Universe is an illusion—Maya(Vedanta Sutra II. 1.23). The world and its experinces are likened to dream-state.

3.—*Philosophy of Life and Reality :*

Philosophy of life embraces every aspect of life—Reason (Pure Thought), Will (Practical Thought), Insight (Divine Contemplation of Aristotle, Rational insight of Bradley, Vitalela of Bergson.)

James' Varieties of Religious Experience establishes beyond doubt the reality of the Unseen—' the more ' of human experience—which in religious terminology is God.

Cosmological, Teleological and Ontological arguments, though may not conclusively prove God, yet in unmistakable terms point to the fact of His existence.

God, as the immediate, as well as, the ultimate fact of reality, is ever-creative.

The universe is the visible manifestation of the unmanifest. It is a vale of soul-making.

Meaning of creation, emergence, evolution, concretion and ingression.

Man as an embodied self, is a creation after His image. Creation in His image means creation of man as a free-willed agent, having discerning light of reason, self-determining power of Will and ever seeking and burning love for communion with his Creator.

Body is the temple of the Living God.

Cosmos—pebbles of Newton, a flower in the cranied wall of Wordsworth, a green leaf of the Persian Mystic, Saadi, enlightened conscience of a moral person—all disclose His magnificence, beauty, order and goodness respectively.

Kali Prasad.

(1) *Behaviorist Account of Emotion: A critique:* (Proc. Indian Philosophical Congress, 1929).

The recent researches of Cannon and Sherrington have entirely discredited all peripheral and atomistic hypotheses of emotion. The Behaviorist attempt to force all mental facts into the mould of S – R formula has been shown to be hopelessly misconceived. But while the central factor is rightly emphasised by Cannon, the latter's 'thalamic theory' has hardly justified itself. In view of the difficulties, a new line of explanation is suggested in terms of the Gestalt theory.

(2) *A theory of Emotion in the light of Gestalt Psychology* (Proc. Indian Philosophical Congress, 1930).

The theory suggested in the earlier paper is here further developed and elaborated. In the light of such experiences as for instance, the ' phi-phenomenon ', emotion has been shown to be a dynamic experience conforming to the well known laws of 'dynamic wholes' or ' gestalten'.

(3) *A Gestalt approach to the Concept of the Unconscious* (Proc. Indian Philosophical Congress, 1931).

Most theories of the unconscious develop on the assumption that the ordinary principles of normal Psychology have hardly any application in this domain. The paper challenges this assumption. An attempt has been made to show that the unconscious, like the conscious, exhibits the same laws and tendencies as are characteristic of all gestalten. For instance, the principles of 'closure' and 'pregnancy' explain and illustrate the various manifestations of the unconscious phenomena, as much as the course of conscious life.

(4) *Vedanta Solution of the Problem of Evil:* (British Journal of Philosophical Studies, London, 1930).

Ordinarily it is supposed that Absolute Idealism breaks down in view of the problem of evil. A solution of this problem is attempted in the light of the Vedanta. Vedantic absolutism accepts the *fact* of evil but denies its *reality*. It emphasises the concrete character of Absolute experience which, though it may be obviously impossible to *describe*, is none the less perfectly *realisable*, as is indeed shown by rais of the Upanishads Incidentally a new view of transmigration is suggested.

(5) *Self in Relation to Knowledge:* (A symposium): (Proc. Indian Philosophical Congress, 1931).

Self cannot be regarded (at least epistemologically) as a substance or an entity whether permanent or otherwise. Self-experience, like other experiences, has certain conditions and characteristics. These may be often described as 'unity' 'permanence', 'identity' etc. But the self itself *is not* any of these. The confusion, however, arises when we identify the self with its 'conditions' in short, by a 'fallacy of identification.' In itself it is simple and indefinable, and knowledge is one of its conditions.

DEPARTMENT OF EUROPEAN HISTORY.

S. N. Das Gupta.

Articles :

(1) *Relation of the Paramars of Malwa with Neighbouring States and the South during the Tenth and Eleventh Centuries A. D.:* (Journal of the U. P. Historical Society, Vol. V, January, 1932, Part I).

(2) *An Attempt at a Genealogy of the Paramaras of Malwa:* (In Press).

DEPARTMENT OF INDIAN HISTORY.

Radha Kumud Mookerji.

(*a*) *Book* :

Asoka: (Messrs Macmillan and Co., Ltd., London).

The book is designated as Gaekwad Lectures in connexion with the Sayaji Rao Gaekwad Prize of Rs. 7,000, awarded to Dr. R. K. Mookerji by the Government of Baroda. It contains the text, translation, and annotation of the inscriptions of Asoka, illustrations of Asokan Monuments, and chapters on different aspects of his life and reign, such as Administration, Religion, Social conditions, together with Appendices on Asokan Grammar and other special topics.

(*b*) *Articles and Papers :*

(1) *On Hindu Religion and Charitable Endowments—a historical retrospect:* (Lucknow, 1928).

(2) *Aspects of Co-operation in Ancient India:* (Paper published by the Mysore Provincial Co-operation Conference, 1928).

(3) *Later Gupta History and Chronology :* (Journal of Indian History).

(4) *Later Guptas of Magadha :* (Journal of Bihar and Orissa Research Society).

(5) *Authenticity of Asokan Legends :* (Allahabad Oriental Conference).

(6) *Chronology of Asokan Edicts :* (Allahabad Oriental Conference).

(7) *Minor Rock Edict I of Asoka re-considered* : (Allahabad Oriental Conference).

(8) *Parallelism between Kautilya's "Arthasāstra" and Asokan Inscriptions :* (Lahore Oriental Conference).

(9) *Asokan Dates :* (Patna Oriental Conference).

(10) *Protection of Minorities :* (Indian Affairs, London, 1929).

(11) *International Protection of Minorities :* (Calcutta Weekly Notes, 1931,)

(12) *Six Bulletins on Minority Problems :* The Modern Review, the Hindustan Review, the Leader, and the Hindustan Times).

(13) *Buddhist Education from the Jatakas :* (Buddhistic Studies, 1931).

(14) *Ancient Indian Education from the Smritis :* (Malaviya Commemoration Volume).

Charan Das Chatterji.

An article on *Some Numismatic data in Pali Literature :* (Buddhistic Studies 1931 pp. 383-453), throwing new light on ancient Indian Numismatics.

Post-graduate Research.

Ashirvadi Lal Srivastava, M. A., was awarded the degree of Ph. D. on his Thesis on *The First two Nawabs of Oudh* published with a Foreword by Sir Jadu Nath Sarkar, Kt., C.I.E., who describes it as a piece of " scientific history to which scholars will have to turn for a long time to come as the standard history " and as " marking the high water mark of scholarship in Doctorate Theses, reflecting equal credit on the author who wrote it and the University of Lucknow which made him write it."

Nanda Lal Chatterji.

Papers :

(1) *Mir Qasim's Intrigues against Mir Jafar, Nawab of Bengal :* (Journal of Indian History, Vol. X, Part I).

(2) *The Revolution of 1750 at Murshidabad :* (Journal of the U. P. Historical Society, Vol. V, Part I).

(3) *Mir Qasim's accession to the Masnad of Murshidabad :* (Calcutta Review, Vol. 43, No. I).

(4) *Mir Qasim at Patna :* (Journal of the Bihar and Orissa Research Society, Vol. XVIIII, Parts III-IV).

(5) *The Beginning of Mir Qasim's disputes with the English :* (Journal of Indian History, Vol. XI, Part II).

(6) *Mir Qasim at Monghyr:* (Indian Historical Quarterly, Vol. VIII, No. III).

(7) *Mir Qasim's Expedition against Nepal :* (Calcutta Review, Vol. 44, No. II).

(8) *The Early Phase of Mir Qāsim's Career:* (Calcutta Review, Vol. 44, No. III).

(9) *Mir Qasim's attitude towards the private inland trade of the English:* (Calcutta Review, Vol. 44, No. IV).

(10) *Vansittart's Mission to Mir Qasim, 1762:* (Journal of the Andhra Historical Research Society, Vol. VII, Part I).

DEPARTMENT OF POLITICAL SCIENCE.

V. S. Ram.

(*a*) *Book*

India and the League of Nations—(in collaboration with **B. M. Sharma**, with a foreword by Sir K. V. Reddy, Lucknow, 1932).

This book deals with the circumstances under which the League came into existence, its working during the first decade of its existence, and the position of India therein.

(*b*) *Articles and Papers.*

(1) *The Status of Protectorates and Spheres of Influences in International Law.* (International Law Association London University, November, 1929).

This paper discusses the law of persons and personality in International Law, with special reference to the status of States like Tibet, Nepal, Bhootan, Sarawak and the Persian Gulf States.

(2) *The Status of Indian States in International Law:* (Read before the Geneva School of International Studies, July, 1929).

This paper discusses the position of Indian States like Hyderabad, Mysore, etc., in the Constitutional Law of the Empire and also from the standpoint of International Law.

(3) *International Law in Ancient India:* (Read before the Academy of International Law at the Hague in August, 1929).

This paper traces the growth of International Law and customs in Ancient India, including the nature and sources of International law in the ancient world, and the laws of land warfare, diplomacy, and neutrality in India from the Fifth Century B. C. to the Tenth Century A. D.

(4) *Presidential Address at the Tenth Andhra Provincial Students Conference*:

This paper describes the principles of Social Service and their application to poor relief, unemployment, University settlements, etc.

(5) *Municipal Government in Japan* (The Local Self Government Quarterly, April, 1932, Madras).

The writer traces the history and development of municipal institutions in Japan in the Meiji Era and compares them with the municipal institutions of England, France, U. S. A., and India.

(6) *Rural Government in Japan:* (The Quarterly Journal of the Local Self-Government Institute, Bombay, April, 1932).

A study of village government and institutions of Japan in modern times from a comparative point of view.

(7) *The Law of Nations and its Jurisdiction:* (The Madras Law College Magazine, December, 1932).

(8) *Municipal Government in the U. S. A.:* (The Local Self-Government Quarterly, October, 1932, Madras).

A brief survey of the various forms of Municipal Government in the United States of America with their respective merits and demerits from a comparative point of view. Special stress has been laid on the working of direct democracy through such forms as referendum, recall and the initiative.

(9) *Recent Changes in Municipal Government in Germany:* (The Quarterly Journal of the Local Self-Government Institute, Bombay, October, 1932).

Post-war changes in the organisation, functions, and powers of German municipalities have been examined in detail. The effects of the abolition of the three class system of voting and the substitution of universal suffrage and Proportional Representation have been critically discussed along with changes in forms of Government. The causes of the success of Municipal Socialism in Germany have been analysed and comparisons and contrasts with other European and American cities have been drawn, deducing lessons for Indian cities.

(10) *The Government of Tokyo*—(in collaboration with **A.L. Loomba**): (The Quarterly Journal of the Local Self-Government Institute, Bombay. December, 1932).

This paper deals with the reconstruction of the city of Tokyo after the earthquake of 1923, with special reference to the problems of town-planning, public health and sanitation. Latest innovations like the Braille Ballot, changes in the methods of voting and structural changes in the form of Government have also been discussed in detail.

E. Asirvatham.

(*a*) *Books*:

(1) *Christianity and the New Social Order*: (Part of Sat Tal Message, 1932—Y.M.C.A. Press, Calcutta).

It seeks to apply the teachings of Jesus to the social, economic, and political conditions of our day.

(2) *A Monograph on the Principles and Methods of Social Service*: (S.C.A. publication, 1932, Allahabad).

It is a study of the fundamental principles underlying successful social service in the West, and particularly in America, and an application of these principles to Indian conditions.

(*b*) *Articles and Papers*.

(1) *Social Justice* (Madras Christian College Magazine, October, 1928).

It is an elaboration of the doctrine of equal opportunity to all and the doctrine of stewardship as regards wealth, and emphasises the need of the simple life. It was reprinted by the Indian Educator in 1929.

(2) *Training in Citizenship*. (U. P. Secondary Educational Conference, 1929).

It concerns itself with a philosophy of citizenship and the art of practising it. In the first part, attention is directed to a proper view of the State and a correct understanding of the relation between rights and duties. The second half deals with particular situations to which the spirit of good citizenship

may be applied. The approach to the subject is from the standpoint of the idealistic theory of the State.

(3) *Liberty :* (The Indian Educator, 1929).

It is partly an exposition of Mill's essay on Liberty and partly an exposition of the different senses in which the term is used by political writers in the West.

(4) *Distribution of Economic Goods :* (The Indian Educator, February, April, May and June, 1931).

It is a study of problems relating to the just distribution of wealth from (a) the individualistic, (b) the socialistic, (c) the communistic, and (d) the idealistic points of view, the conclusion being in favour of a combination of the socialistic and idealistic points of view.

(5) *Indian Youth and Religion :* (World's Youth, Geneva, April, 1932).

It is an exposition of present-day thought movements among Indian youth, and an attempt to re-interpret the values of religion in the light of new tendencies.

(6) *Appreciation of Socialism* : (Lucknow University Journal, Annual Number, 1932).

It is a dispassionate study of the merits and demerits of socialism and an endeavour to discover the best elements of socialism.

B. M. Sharma.

Books .

(1) *Federal Polity*—(with a foreword by Mr. A. Rangaswami Iyengar) : (Upper India Publishing House, Lucknow, 1931).

This book deals with the principles of Federalism and the growth and development of federal institutions in the principal countries of the world. It is the first effort of its kind in India since the publication of Sir Fredrick Whyte's monograph.

(2) *India and the League of Nations*—(in collaboration with **V. S. Ram**) : (Upper India Publishing House, Lucknow, 1932).

(3) *The Indian Federation*—(with a foreword by Mr. C. Y. Chintamani) : (Upper India Publishing House, Lucknow, 1932).

This is the Doctorate Thesis of the author. It is also the first book in the series " Lucknow University Studies in Political Science." The book discusses the general principles of Federalism and their application to Indian conditions. The problem of Indian States, and the position of Minorities in the new constitutions are discussed in detail.

Research Work in Progress :

(1) *Political Theory and Modern Governments:* (**V.S. Ram, E. Asirvatham, and B. M. Sharma**).

This is the second book in the Series " Lucknow University Studies in Political Science ". (In Press).

This work is divided into three parts : Political theory, Unitary Governments, and Federal Governments. It places before the student the main currents of political theory and an analysis of the constitutions of some of the principal countries of the world. Attempt is made wherever possible to interpret Indian political thought and conditions in the light of Western political theory and practice.

(2) *Governments of Asia*—(**V. S. Ram** in collaboration with **B. M. Sharma**) :

This work includes a detailed study of the Governments of Japan, China, Siam, Afghanistan, Persia, Iraq, Egypt, and Turkey. It will also deal with the Governments of dependencies, such as Korea, Formosa, Phillippines, Indo-China, Java, and Straits Settlements.

E. Asirvatham.

(1) *A History of Western Political Thought.*

(2) *Principles and Methods of State Interference.*

It will deal with the various theories of State Action and the responsibility of the State in the matter of social amelioration.

V. K. Nandan Menon.

The Indian Public Service.

A critical study of its past, present and future. It deals with the central and provincial services, and in particular with the problem of services in the future Indian Federation. It also discusses the adequacy of its organisation, powers and procedure with reference to the needs of a modern State.

The following Research Scholars are working for their Doctorates :—

(1) **A. L. Loomba.**—*Local and Municipal Government in the U. P.*

(2) **Sri Kant Varma.**—*Dyarchy with special reference to the U. P.*

(3) **P. N. Mehrotra.**—*Social Legislation in India.*

(4) **A. J. Shaw.**—*The State and Social Amelioration.*

(5) **Shanti Narayan Varma.**—*Public Opinion and Popular Government in India.*

(6) **Radhey Raman Lal Saksena.**—*Legislative Procedure in India.*

DEPARTMENT OF ECONOMICS AND SOCIOLOGY.

Radhakamal Mukerjee.

(*a*) *Books :*

(1) *An Introduction to Social Psychology*—(in collaboration with **N. N. Sen Gupta**): (American Edition: Heath and Co., in the Health Social Relations Series under the general editorship of Jerome Davis, Yale University: 304 pp., 1928—British Edition: George G. Harrap and Co., with an introduction by Professor Yerkes).

" It is the joint work of a psychologist and a sociologist, attacks the problems of social behaviour with the weapons of the stimulus-response psychology, endeavouring to give the more important factors that determine different types of conduct not only of groups, but also of individuals so far as the influence of the group affects the interest and pattern of the individual mind and behaviour". Several chapters are devoted to the analysis of behaviour on crowds, while social changes and pathological social phenomena associated with modern economic life are subjected to a psychological examination. Each chapter is followed by suitable review problems and references from periodicals for further reading.

(2) *The Land Problems of India*—(Calcutta University Readership Lectures) : (Longmans, Green and Co. Announced for publication—375 pp.)

The book gives a comparative and historical survey of different types of land holding and village communities in India, and attempts an examination of the economic effects of different tenures as well as of recent land legislation in the different provinces. The principles of land revenue assessment and effects of the land system on public finance are also discussed. Incidentally the trend of agrarian reform in the agricultural countries of the West is analysed to throw light on the present position and future of the land system in India.

As a member of the Provincial Banking Enquiry Committee, U. P., Dr. Mukerjee furnished certain memoranda and contributed towards the final drafting of the Report. He has been the cooperating editor of the *Journal of Sociology and Social Research*, published at the University of South California, U. S. A., and also in the Board of Editors of the *Indian Journal of Economics*. He has been recently nominated a correspondante of the Italian Committee for the study of the problems of world population.

(*b*) *Articles, Papers, and Memoranda :*

(1) *The Agricultural Regions of the Ganges Valley :* (The Indian Journal of Economics, January, 1928).

(2) *Agricultural Contrasts in the Bengal Delta:* (The Indian Journal of Economics, July, 1928).

(3) *The Concentration of Population in Eastern Bengal:* (The Indian Journal of Economics, October, 1928).

(4) *Social Ecology of the Ganges Valley:* (Journal of Sociology and Social Research, University of Southern California, March-April, 1928).

(5) *Presidential Address before the Madras Provincial Co-operative Conference which held its sitting at Rajamundry:* (Madras Co-operative Journal, 1928).

(6) *The Future of the Indian Land Tenure:* (Indian Journal of Economics, January, 1929).

(7) *Religion as a Social Norm:* (The Sociological Review. London, July, 1929).

(8) *The Social Conception of Religion:* (Journal of Sociology and Social Research, University of South California, 1929).

(9) *Roots of Religion:* (Journal of Social Forces, University of North Carolina, September, 1929).

(10) *Agricultural Cycles and Sunspots:* (Indian Journal of Economics, November, 1929).

(11) *Diet of the Industrial Workers:* (Report of the Royal Labour Commission, Evidence Volume).

(12) *Agrarian Unsettlement in India:* (The Indian Journal of Economics, 1930).

(13) *Religious Experience:* (The Sociological Review, London, 1930).

(14) *Religion and Economic Life:* (The New Age, 1930).

(15) *Psychology of Rites:* (The Indian Journal of Psychology, 1930).

(16) *Religion and Human Relations:* (Proc. Indian Philosophical Congress, 1930).

(17) *Regional Balance of Man:* (American Journal of Sociology, 1930).

(18) *Optimum and Over-Population.* (Indian Journal of Economics, 1931).

(19) *The Co-ordination and Consolidation of Indian Banking :* (Provincial Banking Enquiry Committee Report, U. P., Vol. II).

(20) *The Small Industries of Lucknow :* (Provincial Banking Enquiry Report, U. P., Vol. II).

(21) *Fluctuations of River and Economic Life in the Deltaic Region :* (Indian Journal of Economics, 1931).

(22) *The Relation between Crops and Population Density in Bihar :* (Indian Journal of Economics, 1931).

(23) *Ecological Contributions to Sociology :* (The Sociological Review, London, 1931).

(24) *Food and Food Requirements of Indian Labourers :* Proc. Indian Economic Conference, 1931).

(25) *Population Balance and Optimum :* (Proc. of the International Congress for the study of Population Problems, Rome, November, 1931).

(26) *The Salt Tax in India :* (Indian Journal of Economics, 1931).

(27) *The Processes of Regional Balance :* (The Sociological Review, London, 1932).

(28) *Sanctity and Society :* (The Golden Book of Tagore, 1932).

(29) *The Gift of the Ganges—a geographical study of population groups :* (The Malaviya Commemoration Volume, 1932).

(30) *Memorandum on Restriction of the Transfer of Land :* (Agricultural Debt Committee Report, U. P.).

(31) *The Concepts of Balance and Organisation in Social Ecology:* (Journal of Sociology and Social Research, University of California, July, 1932).

(32) *The Concepts of Distribution and Succession in Social Ecology:* (Journal of Social Forces, University of North Carolina, October, 1932).

(33) *The Ecological Outlook in Sociology:* (American Journal of Sociology, November, 1932).

(34) *The Environmental Control of the Population Movement in Northern India:* (The P. C. Ray Commemoration Vol., 1932).

(35) *Economic Values and Reconstructions* · (Presidential Address at the 16th Indian Economic Conference, Delhi).

(36) *Sociology and Mysticism:* (Journal of Sociology and Social Research, University of California, March-April, 1932).

(37) *Article on Land Tenures in India:* (The Encyclopædia of the Social Sciences—Edited by Professor E. Seligman, New York).

(38) *A Tribute to Patrick Geddes:* (The Sociological Review, London, October, 1932).

Bhujanga Bhushan Mukherjee.

Articles, Papers and Memoranda:

(1) *Provincial Co-operative Banks in the United Provinces.*

(2) *Co-operative Education.*

(3) *Co-operation and Public Health:* (Nos. 1-3 published in the Proceedings of the Thirteenth United Provinces Co-operative Conference. Government Press, Allahabad.)

(4) *The Reserve Bank and the Co-operative Movement.*

(5) *Land Mortgage Bank in the United Provinces:* (Nos. 4-5 published in the Proceedings of the Fourteenth United Provinces Co-operative Conference. Government Press, Allahabad).

(6) *Economic and Sociological Consequences of our Marriage Laws:* (Memorandum submitted to the Age of Consent Committee, 1929—Age of Consent Committee Report, Vol. IX. Government Press, Calcutta).

(7) *Urbs Prima in Indis:* (Calcutta Municipal Gazette, Christmas Number, 1929).

(8) *Economics of Municipal Enterprise:* (Calcutta Municipal Gazette, Sixth Anniversary Number, 1930).

(9) *Provincial Co-operative Banks in the United Provinces:* (Memorandum submitted to the United Provinces Banking Enquiry Committee, 1930—Report of the U. P. Banking Committee, Vol. IV—Government Press, Allahabad).

(10) *Banking in India:* (Memorandum submitted to the Indian Central Banking Enquiry Committee, 1930—Indian Central Banking Committee Report, 1931. Government Press, Calcutta).

(11) *Protection for the Paper Industry in India:* (Memorandum submitted to the Indian Tariff Board, 1931—Indian Tariff Board, Protection for Paper Volume).

(12) *Representation of Indian Labour and other interests:* (Memorandum submitted to the Lord Lothian Indian Franchise Committee of 1932—Memoranda Volumes of the Report of the Indian Franchise Committee, 1932).

Bhujanga Bhushan Mukherjee has also been editing the United Provinces Co-operative Journal which is published quarterly by the Co-operative Department in the United Provinces.

Hirendra Lal Dey.

(*a*) *Book :*

The Indian Tariff Problem in relation to Industry and Taxation : (Thesis approved for the Degree of Doctor of Science, Economics, in the University of London. Published by Messrs. George Allen and Unwin).

In this work is attempted, for the first time, a scientific enquiry into the root assumptions and principles governing the Indian tariff experiment during the last ten years. It also investigates the technique of tariff-making and contains a discussion of tariffs as a protective remedy for the major Indian industries, like cotton, steel, and sugar. The exposition of the central theme is preceded by an analysis of the incidence of protective tariffs in India. In conclusion have been indicated the lines on which should be developed a more rational policy and a more scientific technique of tariff administration. The work is enriched with tables and graphs, and with a descriptive bibliography and with an index.

(*b*) *Papers .*

(1) *The Progress of the Steel Industry, 1924-27—How far it was due to Protection .* (Indian Journal of Economics, July, 1928).

(2) *The Indian Tinplate Industry—A study in comparative advantages :* (Indian Journal of Economics, October, 1928).

(3) *A Plea for Industrial Banks :* (Calcutta Commercial Gazette, 24th December, 1928).

(4) *The Distributional Aspect of Protective Duties in India :* (Indian Journal of Economics, October, 1932).

Dhurjati Prasad Mukerji.

(*a*) *Book :*

The Basic Concepts in Sociology. (Kegan Paul, London, 1932).

In this book the author attempts to remove the myths in sociological thinking by a searching analysis of its current assumptions. The abiding elements in the notions of Progress, Equality, Social Force and Social Control are discussed and receive a new significance from their relations to Personality, which is claimed to be the cardinal point of view of Sociology.

(*b*) *Papers* .

(1) *A Case for Social Insurance for Indian Labourers*. (Proc. Indian Economic Conference, 1928).

(2) *Group-Insurance* (Special Number of "Liberty", October, 1929).

(3) *Civic Consciousness*. (Special Number of the Calcutta Municipal Gazette, November, 1929).

(4) *Human Principles of City Planning :* (Sixth Anniversary Number of the Calcutta Municipal Gazette, November, 1930).

(5) *Psychological basis of Social Forces :* (Proc. Indian Philosophical Congress, December, 1930).

(6) *Progress and Personality :* (Vishwabharti Quarterly, October-December, 1930).

(7) *Equality:* (Vishwabharti Quarterly, March, 1931).

(8) *Civic Sense :* (Calcutta Municipal Gazette, July, 1932).

D. N. Majumdar.

Papers :

(1) *Death and Connected Ceremonies of the Hos of Kolhan :* (Journal of the Asiatic Society of Bengal, 1928).

(2) *Bigonial Length of the Hos :* (Journal of the Asiatic Society of Bengal, 1928).

(3) *Some of the Worship-festivals of the Hos :* (Journal of the Asiatic Society of Bengal, 1928).

(4) *A few types of Kolarian Songs :* (Journal of the Asiatic Society of Bengal, 1928).

(5) *Maternity and Couvade in Primitive Society :* (Man in India, Vol. IX, 1929).

(6) *Race and Adaptability :* (Journal of the Asiatic Society of Bengal, Vol. XXV, 1929).

(7) *Witch and Witchcraft in Primitive Society :* (Proc. Indian Science Congress, 1929, and Man in India, Vol. IX, 1929).

(8) *Sex and Sex-Control in Primitive Society :* (Man in India, 1929, Vol. IX).

(9) *Social Organisation among the Korwas.* (Man in India, Vol. X).

(10) *The Korwas of the U. P. :* (Man in India, Vol IX).

(11) *Totemism and Origin of Clans :* (Journal of the American Oriental Society, Vol 50, No. 3).

(12) *Economic Background of Social Institutions :* (Man in India, Vol. X).

(13) *The Darlung Kukis of Assam :* (Proc. Oriental Conference, 1930).

(14) *Economic Life of the Hos of Kolhan:* (Proc. Oriental Conference, 1930).

(15) *Sorcery and Divination amongst the Hos:* (Proc. Oriental Conference, 1930).

(16) *The clash and fusion of cultures in Pergunna Dudhi:* (Proc. Oriental Conference, 1930).

(17) *The Role of family among the Hos:* (Proc. Oriental Conference, 1930).

[Nos. 13 to 17 have been separately published in Man in India].

(18) *The Cycle of life among the Korwas:* (Proc. Indian Science Congress, 1930, also Man in India, Vol. XII, Nos. 3 and 4).

(19) *Disease, Death and Divination in Primitive Society:* (Man in India, Vol. XII).

(20) *Forms and Functions of Primitive Religion:* Proc. Indian Science Congress, 1931).

(21) *Economic Life of the Korwas:* (Proc. Indian Science Congress, 1931).

(22) *Marital Problem, a new orientation:* (Man in India, Vol. XII, Nos. 1 and 2).

Post-Graduate students :

Books, Monographs, and Papers:

(1) *Fields and Farmers in Oudh*—(with an introduction by **Radhakamal Mukerjee**) : (Longmans, Green & Co., 1928) containing the following surveys :—

(*a*) *An agricultural survey of Bakshi-ka-talab in Lucknow District*—by **G. Sahai.**

(*b*) *A Social and economic survey of Malhera in Hardoi District*— by **K. S. Saxena.**

(*c*) *Agricultural Labour in Unao District*—by **H. Dayal.**

(2) *Economic Surveys of Villages Kupa, Chattara and Edalpur, Muttra District*—by **B. N. Bhargava**: (Provincial Banking Enquiry Committee Report, U. P., Vol. II).

(3) *Economic Surveys of Villages Bhensa, Pasounda, Khiwai and Bhatrayana, Meerut District*—by **Kunwar Bahadur**: (Provincial Banking Enquiry Committee Report, U. P., Vol. II).

(4) *A Survey of Cottage and Artistic Industries in Lucknow City*—by **A. Bhattacharya**: (U. P. Provincial Banking Enquiry Committee Report, Vol. II).

(5) *A Survey of Cottage and Artistic Industries in Benares City* by **S. Majumdar**: (U. P. Provincial Banking Enquiry Committee Report, Vol. II).

(6) *Agricultural Marketing*—(with a foreword by **Radhakamal Mukerjee**—by **B. N. Bhargava**: (Longmans, Green & Co., 1930).

(7) *Wages and Cost of Living of Industrial Labourers in Cawnpore*— by **Sitla Prasad Saksena**: (Royal Commission on Labour Report, Evidence Vol., 1930).

(8) *The Pressure of Population and its effects on Rural Economy in Gorakhpur District*—(with an introduction by **Radhakamal Mukerjee**)—by **J. K. Mathur**: (Bulletin No. 50, U. P. Government Press).

(9) *Over-Population in Jaunpur*—(with an introduction by **Radhakamal Mukerjee**)—by **Bhola Nath Misra**: (Bulletin No. 59, U. P. Government Press, 1932).

(10) *Organisation of Wheat Trade in the North-Western Region, U. P.*—(with an introduction by **Radhakamal Mukerjee**)—by **Tiryugi Prasad:** (Bulletin No. 51, U. P. Government Press, 1932).

(11) *Social and Economic Survey of a village in Cawnpore District*—(with an introduction by **Radhakamal Mukerjee**)—by **B. R. Misra:** (Bulletin No. 46, U. P. Government Press).

(12) *Marriage and Marital Life among the Rawalttas of Rawain*—by **S. D. Bahuguna:** (Proc. Indian Science Congress, 1931, and also published in Man in India).

(13) *Religious Life among the Rawalttas*—by **S. D. Bahuguna:** (Proc. Indian Science Congress, 1931.)

(14) *Festivals among the Rawalttas*—by **S. D. Bahuguna:** Man in India Vol. X).

(15) *The Social and Economic Life of the Cheros*—by **D. D. Agarwal:** (Man in India, Vol. IX).

(16) *The Tharus of Naini Tal*—by **Hari Dev :** (Man in India, Vol. XII, 1932).

Raj Bahadur Gupta's doctorate thesis in Economics entitled *Labour and Housing in India*, with an introduction by **Radhakamal Mukerjee**, was published by Messrs Longmans, Green & Co. in 1930. 264 pp. This is a first-hand survey of industrial housing in India, and also deals with housing and town-planning reform.

B. S. Haikerwal's doctorate thesis on *Social and Economic Conditions of Crime in India* has been approved for publication by Messrs George Allen Unwin & Co.

Research Work in Progress :

Radhakamal Mukerjee.

(1) *Population theories and population problems with special reference to India.*

(2) *The Social Ecology of Man.*

(3) *Emigration Problems of the East.*

[Papers on the above subjects are being published in Scientific Journals].

Bhujanga Bhushan Mukherjee.

External Capital and its consequences.

Hirendra Lal Dey.

(1) *The World Economic Depression with special reference to India.*

(2) *The present position of the Indian Cotton and Sugar Industries.*

(3) *The Central Banking System with special reference to the proposed Reserve Bank of India.*

(4) *A critical examination of the Theory of Protection with special reference to India.*

Dhurjati Prasad Mukerji.

(1) *Over-Population in India.*

(2) *Civic Sense.*

D. N. Majumdar

(1) *Kolhan and Its people.*

(2) *Culture and Control in Primitive Society.*

[Chapters from the above forthcoming publications are being printed in different Scientific Journals].

(3) *The Study of Culture Contacts between higher and lower groups in India.*

Post-Graduate students.

Shiva Darshan Pant:—*The Social Economy of the Himalayans:* (Based on a survey in the Kumaon-Himalayas), already approved for the degree of doctorate.

S. P. Saksena:— *Wages and Cost of Living of Industrial Labourers in India.*

S. C. Paracer:— *The Industrial Efficiency of the Indian Labourer.*

Kailash Chandra Sarkar:—*Forms of Land Settlement and Utilisation in Northern India.*

DEPARTMENT OF ARABIC.

M. Z. Siddiqi.

(1) *The Life and Works of Prof. E. G. Browne*: Dealing with the origin and growth of the Bahi and Bahai sects in Islam, the European literature on the subject and Browne's contribution to that literature. (Jamia, January, 1928).

(2) *Fairs in pre-Islamic Arabia*: (A paper read in the Oriental Conference, Lahore, December, 1928).

M. Wahid Mirza.

(1) *The Life and Works of Amir Khusrau:* A thesis accepted for the Ph. D. degree of the London University in 1929. (Not yet published).

Paper.

Urwa, the Beggar Minstrel of Arabia : (Read at the Biennial session of the Oriental Conference, Patna, December, 1930).

Khalil Ibn Mohammad Arab has been collecting material for a comprehensive work on the poets of Yemen and is preparing a critical edition of the 5th volume of the rare and valuable work 'Kitab-ul-taqasim-i-wal-anwar' by Ibn Habban, a good manuscript of which he has been able to procure in Lucknow.

DEPARTMENT OF PERSIAN AND URDU.

Syed Masud Hasan Rizavi.

(*a*) *Books :*

(1) *Hamari Shairi :* (Revised edition—Nizami Press, Lucknow, 1929).

An explanation of the sense and symbolism of Urdu poetry and the true meaning and significance of the various emotions that it stands for, with a special reference to the charges levelled against it by its present day critics.

(2) *Faiz-i-Mir :* (Kitabghar, Lucknow, 1929).

A very rare work of the great poet 'Mir', edited with an Introduction and Urdu translation. Published for the first time more than 150 years after the date of its writing.

(3) *Majalis-i-Rangin :* (Kitabghar, Lucknow, 1929).

A rare book by 'Rangin' of Delhi, containing anecdotes about contemporary poets, edited with an Introduction and indexes.

(4) *Jawahir-i-Sukhan, Vol. II :*

A voluminous anthology of Urdu poetry compiled under the auspices of the Hindustani Academy, U. P., revised and edited with an Introduction.

(5) *Ruh-i-Anis :* (The Indian Press, Ltd., Allahabad. 1931).

A collection of the best poems of Anis corrected by collating several manuscripts and edited with an Introduction, glossary, and critical and explanatory notes.

(6) *Nizam-i-Urdu :* (The United India Press, Lucknow, 1931).

An original work of Sayyid Anwar Husain 'Arzu' of Lucknow, aiming at presenting a criterion for judging the purity and chastity of language in an Urdu composition and laying down principles for using the right word in the right place, revised and edited with an Introduction and explanatory notes.

(*b*) *Articles :*

(1) *Mir Anis ke Kuchh Chashmdid Halat :* (The Adab, Lucknow, December, 1931).

Some particulars of the life of Anis as given by two eye-witnesses.

(2) *Mir Anis ki Sirat :* (The Adab, Lucknow, December, 1929).

The character of Anis and the light thrown on it by his own writings.

(3) *Mir Anis ki 'Ilmi Istidad :* (The Adab, Lucknow, January, 1932).

The scholarship of Anis as evinced by his own work.

(4) *Mir Anis ke Kalam men Sanaton ka Istimal:* (The Zamana, Cawnpore, May, 1928).

Anis's skill and ingenuity in the use of rhetorical artifices and figures of speech.

(5) *Mubahasa:* (The Zamana, Cawnpore, January, 1930).

Some objections on the above article refuted entailing a discussion on certain points of rhetorics.

(6) *Ek Istifsar ka Jawab:* (The Nairang, Rampur, March, 1929).

Two difficult lines explained at a request addressed to the writer.

(7) *Nauha-i-Bismil par Ek Nazar:* (The Nairang, Rampur, July, 1929).

A criticism of an old poem, being an elegy on the death of the 'beloved' by 'Bismil'.

(8) *Mir ki Ek Aur Tasnif:* (The Maktaba, Hyderabad, August and September, 1929).

A critical survey of the then unpublished work of 'Mir' entitled 'Faiz i-Mir.'

(9) *Raf-i-Ishtibah:* (The Haqiqat, Lucknow, October, 1929).

A discussion as to who was really the author of a couplet of which the authorship was the subject of a controversy.

(10) *Kalam-i-Kalim:* (The Adab, Lucknow, October, 1929).

An account of Mohammad Husain 'Kalim' of Delhi, a poet and writer, who flourished in the 18th century, together with his poems culled from various sources.

(11) *Bayan-i-Rangin*. (The Adab, Lucknow, November, 1929).

An account of Saadat Yar Khan 'Rangin' of Delhi, a poet and writer who flourished in the 18th century, and his time, as picked out from his own rare work entitled 'Majalis-i-Rangin.'

(12) *Tuhfat-ul-Hind:* (The Adab, Lucknow, June, 1930).

A description of a very rare manuscript in my own library entitled 'Tuhfal-ul-Hind' written specially for the Emperor Aurangzeb.

(13) *Urdu ki Do Kamyab Kitaben* (The Adab, Lucknow, July, 1930).

Notices of two rare Urdu books, one of them being a translation of the Psalms of David and the other one being a metrical commentary of the Holy Quran.

(14) *Mir ki Aulad:* (The Adab, Lucknow, December, 1930).

An account of the descendants of Mir, the well-known poet.

(15) *Athar-i-Adabiyya:* (Literary relics, a serial article published in twelve issues of the Adab, Lucknow, from January to December, 1930).

(16) *Urdu ka Ek Kadim Shair:* A paper on Sadr-ud-din Mohammad 'Faiz', a poet of the early eigtheenth century, whose works have not been published so far. (Approved by the All-India Oriental Conference held at Patna in 1930).

(17) *Urdu Zaban ke Lughat:* (The Hindustani, Allahabad, January, 1932).

Notices of twenty oldest Urdu glossaries and dictionaries, some of which have never been published.

(18) *Waqia-i-Karbala aur Uske Asbab-o-Nataij:* (The Adab, Lucknow, May, 1931).

The tragedy of Karbala, its causes and effects.

(19) *Mathnawi Asrar-i-Mahabbat:* (The Urdu, Aurangabad, July, 1931).

Notice of a Mathnavi poem by Mahabbat Khan 'Mahabbat' dealing with the love story of Sassi and Punnu.

(20) *Rangin ki Islahen :* (Hewett Hostel Magazine, December, 1931).

The corrections and improvements upon the verses of well-known poets suggested by 'Rangin' of Delhi.

(21) *Lakhnau ke Shahi Kutub Khane aur Qadim Matbe :* (The Adabi Dunya, Lahore, January, 1932).

An account of the libraries of the kings of Oudh and of the earliest printing presses established at Lucknow.

(22) *Urdu Shairi ka Zarrin Ahd :* (The Aligarh Magazine, December, 1932).

A critical survey of the work of the Urdu poets who flourished during the period of a century from the middle of the 12th to the middle of the 13th century A. H., a period which produced most of the greatest Urdu poets, and hence called by the writer the Golden Age of Urdu Poetry.

(23) *Khuda-i-Sukhan Hazrat-i-Mir :* (The Zamana, Cawnpore, December, 1932).

A short account of 'Mir' in the light of modern researches.

(24) *Chaharda Masum :* (The Sarfaraz, Lucknow, December, 1932).

The meaning of the term 'Chaharda Masum' (or the Innocent Fourteen) and the persons to whom it is applied by different writers.

Mohammad Abdul Qavi Fani.

(1) *Qaani's imagery and his skill in the use of similes:* (The Maarif, Azamgarh, June, 1930).

(2) *Qaani's imagination and diction, the figures of Laff-o-nashr and Tarsi.* (The Adab, Lucknow, July, 1930).

(3) *Qaani's position at the royal court of Persia:* (The Maktaba, Hyderabad, June, 1930).

(4) *Qaani's Art, together with a comparative study of some of the famous poets of the Samanids, Ghaznavids, Seljuqs and Atabecs:* (The Urdu, Aurangabad, April, 1930).

(5) *Qaani's morals and his character:* (The Nairang-i-Khayal, Lahore, August, 1930).

(6) *Some particulars af Qaani's life:* (The Maktaba, Hyderabad, November, 1930).

(7) *Qaani's originality and style:* (The Adab, Lucknow, December, 1930).

(8) *Qaani and Khaqani compared:* (The Maarif, Azamgarh, March, 1931).

(9) *Descriptive poetry in Persian:* (The Nairang-i-Khayal, Lahore, Annual Number, 1931).

(10) *The two chief elements of poetry, imagery and imagination:* (The Adabi Dunya, Lahore, January, 1932).

(11) *A critical review of the "Kulliyat-i-Aziz" a collection of Persian poetical works of Khawja Azizuddin Aziz, a famous poet of Lucknow.* (The Hamdam, Lucknow, July, 1932).

Poems:

(1) *A Persian Qasida, commemorating the marriages of the Royal Princes of the house of Nizam at Nice, France:* (The Adabi Dunya, Lahore, June, 1932).

(2) *Gulzar-i-Usmani*, being nine Persian Qasidas, consisting of 567 couplets, in reply to Khaqani, Zahir Faryabi, Urfi and Qaani, representing both classical and modern styles, in honour of H. E. H. The Nizam.

(3) *Naiyyer-i-Saad :* A Persian Qasida, in happy remembrance of an old class fellow of the author, Dr. Nawab S. Ross Masood Jang Bahadur, the V. C., Aligarh Muslim University, in the good old M. A. O. College days.

(4) *Ganjina-i-maani :* A Persian Qasida, in reply to the famous Qasida-i-Lamiyya of Urfi Shirazi.

(5) *Ganj-i-Khusrawani :* Persian Qasidas of the classical type, in honour of H. H. The Nawab of Bhopal.

(6) *Hadiqa-i-Amin* : A Persian Qasida in praise of Nawab Sir Amin Jang Bahadur, Minister-in-waiting on H. E. H. The Nizam.

(7) *A-eena-i-Usmani :* A Persian Qasida in praise of H. E. H. The Nizam, representing the classical style of Khaqani.

[All the poems, excepting No. (1), have been published by the Asi Press, Lucknow].

Yusuf Husain Mosvi.

Articles :

(1) *The didactic element in Urdu ghazal :* (The Adab, Lucknow).

(2) *Armughan-i-Shiraz :* (Nizami Press, Lucknow, 1929).

A monograph on Urfi of Shiraz with a selection of his ghazals.

Syed Mohammad Husain.

(1) *The historical value of the Shahr Ashob of Sauda:* (The Mubassir, Lucknow, January, 1931).

(2) *The Arabs and their nice sense of honour:* (The Mubassir, Lucknow, April, 1931).

(3) *Introduction to the poetry of the Arabs:* (The Adabi Dunya, Lahore, January, 1932).

(4) *A critical commentary on the Qasida-i-Lamiyya of Sauda:* (Din Muhammadi Press, Lucknow, 1930).

(5) *The first fifty ghazals of Mir*—Edited with a critical Introduction): (Adabi Press, Lucknow, 1931).

DEPARTMENT OF SANSKRIT, PRAKRIT LANGUAGES, AND HINDI.

K. A. Subramania Iyer.

Articles and Papers :

(1) *Studies in the Imagery of the Ramayana—I:* (Journal of Oriental Research, Madras, October-December, 1929).

Here the object of the study is, first of all, clearly stated and its need pointed out. An analysis is then made of all the passages in the Ramayana where images occur in greater abundance than elsewhere. It is observed that images occur in abundance chiefly in descriptions and emotional discourses.

(2) *Studies in the Imagery of the Ramayana—II:* (Journal of Oriental Research, Madras, January-March 1930).

Here the sources of Valmiki's imagery are discussed and the respective contributions of external nature, religion scholasticism and ancient legends are clearly distinguished. The question as to how to distinguish between Valmiki's invention

and his inheritance is next discussed. Coming to the objects which play an important part in Valmiki's poetry, the images found in the descriptions of royalty, greatness and splendour are analysed and it is observed that in such descriptions, the Sun, Moon, Fire and other luminous objects form the standard of comparison.

(3) *Studies in the Imagery of the Ramayana—III:* (Journal of Oriental Research, Madras, July-September, 1930).

Images relating to size or 'magnitude' are then taken up and the recurrence in them of mountains, clouds and elephants is pointed out. This leads to the descriptions of the human body and the extraordinary variety of objects which are brought in for the sake of comparison is stressed. It is next shown that some of the best passages in the Ramayana are those which describe men and things in a state of distress and sorrow and the images found in such descriptions are analysed in detail. These are next compared with similar images in the Mahabharata. As descriptions of War and battle play an important part in the Ramayana, images occurring in them are studied in detail.

(4) *Studies in the Imagery of the Ramayana—IV:* (Journal of Oriental Research, Madras, January-March, 1931).

The paper continues the study of the images relating to war, but is chiefly devoted to a study of the descriptions of the tenderer side of life, love, loyalty and devotion. The connection in Valmiki's imagination, between a river and a woman, is emphasised. The persistence of this idea throughout Sanskrit Literature is pointed out.

(5) *Studies in the Imagery of the Ramayana—V:* (Journal of Oriental Research, Madras, July-September, 1931).

The paper begins with a discussion of some of the conclusions of Mr. Diwenkar relating to the imagery of the Ramayana.

The peculiar character of continued metaphors in the Ramayana is noticed. The recurrence of such objects as a snake, fire, ocean, river and army in such metaphors is observed. The paper ends with a statement of the conclusions arrived at during the course of study.

(6) *The use of the prohibitive particle 'ma' in the Trivandrum plays:* (Proc. All-India Oriental Conference, 1928, Vol. I).

Certain peculiarities had been noticed in the use of 'ma' in the Trivandrum plays attributed to Bhasa. They were supposed to be peculiarities of the language of the author. The paper tries to prove that these peculiarities are found, not merely in the plays attributed to Bhasa, but in many other plays found and published in that part of India; some of these peculiarities are also traced to the inscriptions of Aśoka.

(7) *Some more Nyayas—I:* (Journal of Oriental Research, Madras, September-December, 1931).

(8) *Some more Nyayas—II:* (Journal of Oriental Research, Madras, October-December, 1932).

These two papers (and the others which are to follow) are an attempt to bring together all maxims illustrating philosophical principles as are not noticed by Col. Jacob in his learned collection "A Handful of popular Maxims." They have been taken chiefly from the Kashmir Saiva literature.

K. A. Subramania Iyer in collaboration with **Gaya Prasad Dixit.**

The 'Yayāticarita' in the Mahābhārata and the 'Matsyapurāna' a textual and metrical criticism: (Proc. All-India Oriental Conference, 1928, Vol. I).

The 'Yayāticarita' as found in the Mahābharata and the 'Matsyapurāna' presents remarkable textual similarity. An attempt is made to decide which is the earlier version on the basis of metrical evidence. The study has resulted in the recording of a large number of interesting facts which have importance, not merely for the solution of this particular question, but also for tracing the history of Indian prosody. Detailed charts and statistics, prepared at very great labour and industry are given with the paper.

Research Work in Progress :

(1) Further study of Sanskrit Imagery.

(2) A study of the 'Vākyapadīya' of Bhartihari.

(3) Edition of the 'Bhāskarī', a commentary on the 'Isvarapratyabhijñavimarśini' of Abhinavaguptacharya, by Bhāskara Kantha of Kashmir, in collaboration with **Kanti Chandra Pande.**

Badri Nath Shastri.

Kiranavali-Prakasa-Didhiti, Guṇa-nirupana : A commentary of 'Kiranavali-Prakasa,' by Mahamahopadhya Raghunatha Siromani (Saraswati Bhavan Sanskrit Series).

Adya Datta Thakur.

Book :

Pali Prabodha : (Ganga Pustaka-Mala, Lucknow, 1928).

This is the only Pali Grammar in Hindi. The main characteristic of the book is the occasional comparison and contrast with Sanskrit and Hindi forms. A few lessons, from various Pali texts, add further to the usefulness of the book. A glossary of important Pali words is also added at the end as an appendix.

Adya Datta Thakur has also edited the following works of Mahamahopadeshaka Vidyavachaspati Pandit Madhusudan Ojha, of Jaipur :—

(*a*) *Attri-Khyati :* (Steam Printing Press, Lucknow, 1928).

This is an historical work based on the Vedas and Puranas. Herein, are given the histories of Attri Rishi, his son Chandra and his grandson Budha, from whom spring up the race of the Kshattriyas, known as Chandrnvanshis. Incidentally the position of Pratishthanpur, said to be the capital of Ila or Sudyumna, has been discussed.

(*b*) *Devata-nivit* . (Ganga Fine Arts Press, Lucknow, 1929).

This work contains a lucid description of the Vedic Gods. Then follows the description of Rishis and Pitris, their various forms and their proper conception. At the end of the book, a few chapters are devoted to the explanation of Yajnas, their various divisions and accessories.

(*c*) *Indra-vijaya—Part I:* (Ganga Fine Arts Press, Lucknow, 1929).

This is a geographical work, based on researches from the Vedas and Puranas.

(*d*) *Shariraka-Vijnana* — (Second Part) : (Steam Printing Press, Lucknow, 1930).

This is a commentary on the last two chapters of 'Badarayanas rahmastras.' The main characteristic of the work is that the commentator incidentally refers to the views of other commentators like Shankara, Ramanuja and Ballabha, without prejudice and discusses them in detail.

(*e*) *Yajna Vitapa* · (Ganga Fine Arts Press, Lucknow, 1930).

This is a book pertaining to Yajnas and sacrifices.

(*f*) *Indra Vijaya— Part II :* (Ganga Fine Arts Press, Lucknow, 1931).

This part deals with the historical aspect of the Vedic anecdotes. The author, attempts to refute the modern theory that the Aryans were not the main inhabitants of India.

Badri Nath Bhatt.

(*a*) *Books :*

(1) *Lataloo Ram Ji Ralasteri :* (Indian Press, Allahabad, 1928).

A comic novel which deals with various problems confronting Hindu Society.

(2) *Miss American :* (Indian Press, Allahabad, October 1929).

The book is an original social drama in 3 Acts.

(3) *Manusmriti text and Hindi translation*—by Pandit Kameshwar Bhatt: (3rd Edition, Revised. Nirnaya Sagar Press).

(*b*) *Articles :*

(1) *Origin of Some Hindi Idioms :* (All-India Oriental Conference, Lahore, 1928).

(2) *The Consequences of the Contact of Hindi literature with Bengali literature :* (Sudha, July, 1928).

(3) *The Mind and Siddhis :* (Nowam Brahma-Sandesh, June and July, 1928).

(4) *The Pranks of Egoism :* (Nowam Brahma-Sandesh, June and July, 1928).

(5) *Ghaslate Sahitya :* (Vishal Bharat, September, 1928).

In this article the author condemns the tendency of some of the modern Hindi writers of obscene literature.



CHEMISTRY BLOCK, LUCKNOW UNIVERSITY.

FACULTY OF SCIENCE.

Teaching Staff.

Physics -

1. Dr. Wali Mohammad, M. A. (Panj.), B. A. (Cantab.), PH. D. (Göttingen), I. F. S., Professor.
2. Dr. D. B. Deodhar, M. SC. (Alld.), PH. D. (Lond.), F. P. S., Reader.
3. Satyendra Nath Ray Esq., M. SC., B. A., F. P. S. L., A. INST. P., Lecturer.
4. Dr. K. N. Mathur, D. SC. (Alld.), Lecturer.
5. S. K. Dutt Esq., M. SC. (Luck.), Demonstrator.

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4. Miss M. Wallace, B. A. (Minnesota), M. A. (Columbia), Reader.
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6. Dr. A. C. Chatterji, D. SC. (Alld.), Lecturer (*on leave*).
7. Dr. Soorya Narayan Shukla, M. SC. (Luck.), PH. D. (Lond.), Temporary Lecturer.
8. Pearay Lal Asthana Esq., M. SC. (Alld.), Demonstrator.
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4. H. P. Chowdhury Esq., M. SC. (Panj.), D. I. C. (Lond.), Lecturer.
5. S. K. Pande Esq., M. SC. (Panj.), Demonstrator.
6. A. Ramachandra Rao Esq., M. SC. (Luck.), Demonstrator.

Zoology —

1. Dr. Karam Narain Bahl, D. PHIL. (Oxon.), D. SC. (Panj.), Professor.
2. Dr. Gobind Singh Thapar, M. SC. (Panj.), PH. D. (Lond.), Reader.
3. M. L. Bhatia Esq., M. SC. (Panj.), Lecturer.
4. Jagdeswari Dayal Esq., M. SC. (Luck.), Demonstrator.
5. Makund Behari Lal Esq., M. SC. (Luck.), Demonstrator.
6. Dr. (Miss) Mary Austin, PH. D., Teacher.

Mathematics –

1. J. A. Strang Esq., M. A., B. SC. (Edin.), Professor.
2. Dr. Lakshmi Narayan, M. A., D. SC. (Alld.), Reader.
3. Sasadhar Banerji Esq., M. A. (Cal.), Lecturer.
4. Dr. Avadesh Narayan Singh, M. SC. (Alld.), D. SC. (Cal.), Lecturer.

Wali Mohammad continues to be specially interested in the study of the Fine Structure of Spectrum Lines in the *Ultra-Violet* region and has considerably extended the work begun some time ago. The problem of Fine Structure has gained considerable importance in recent years owing to newer developments of Atomic Physics and systematic investigation of several elements fills up a big gap.

D. B. Deodhar has extended his work on Hydrogen Spectrum and has made several interesting contributions on different branches of Spectroscopy especially Band spectra.

Satyendra Nath Ray has his own views about Physics and boldly challenges all classical and modern theories.

Students : Several post-graduate students have contributed articles on different topics.

Wali Mohammad.

(1) *Fine Structure of some lines of Bi in the Ultra-Violet* : (Proc. Indian Science Congress. Allahabad, 1930).

The method employed for the investigation was the same as has been employed by the author in his previous work on Fine Structure of Spectrum Lines. A specially constructed vacuum arc was employed and Quartz Lummer-Gehrcke plates of different dimensions were used in conjunction with a Hilger Quartz Spectrograph for producing the resolved lines. Thus the fine-structure of several lines has been investigated. Their values are given.

(2) *Fine Structure of Silver Lines in the Visible and Ultra-Violet regions:* (Proc. Indian Science Congress, Nagpur, 1931).

The investigation of the Fine Structure of the Silver Lines by means of a Quartz Lummer-Gehrcke plate and a specially

devised source of light has been carried out and the structure of a large number of lines determined.

(3) *Fine Structure of Tellurium Lines in the Visible and the Ultra-Violet regions:* (Proc. Indian Science Congress, Nagpur, 1931).

The investigation of the Fine Structure of the Tellurium Lines by means of a Quartz Lummer-Gehrcke plate and a specially devised source of light has been carried out and the structure of a large number of lines determined.

(4) *Energy levels of Zinc:* (Proc. Indian Science Congress, Nagpur, 1931).

The author's work on the Fine Structure of Zinc Lines in the visible and the ultra-violet regions has been extended and the energy levels of the Zinc lines have been determined and are in agreement between theoretical and experimental values established.

Wali Mohammad and S. B. L. Mathur.

(5) *On the Fine Structure of Spectrum Lines of Thallium in the Ultra-Violet:* (Philosophical Magazine, London, Vol. V. 1928).

This is a continuation of the work on the Fine Structure of Spectrum Lines emitted by arcs of different elements in the ultra-violet regions. The source of light is a specially constructed arc lamp and in all 12 lines in region between λ λ 3800-2580 have been investigated and their fine-structure determined for the first time.

(6) *On the Fine Structure of the Spectrum Lines of Zinc:* (Proc. Indian Science Congress, Madras, 1929).

By means of a Hilger Quartz E_3 spectrograph and a Quartz Lummer plate 13 cms. long and 0·46 mm. thick, the authors have investigated the fine-structure of all the important lines of Zinc between the regions λ 5000 and λ 2756. The source of light was a specially constructed lamp consisting of a Wehnelt Oxycathode of platinum and an anode of Zinc both placed in a water-cooled tube kept exhausted by means of a Cenco-Hyvac Pump. Most of the lines showed a complex structure and the position of the satellites has been fixed both in the Visible and the Ultra-Violet regions.

Wali Mohammad and P. N. Sharma.

(7) *Fine Structure of Zinc Lines in the Visible and the Ultra-Violet regions :* (Philosophical Magazine, London, Vol. X, 1930).

Previous investigations on the fine-structure work confined their attention only to the visible region of the spectrum and so an extensive work has been undertaken to investigate the fine-structure of spectrum lines in the ultra-violet regions, 18 lines of Zinc arc between the region $\lambda\lambda$ 6400 and 2750 have been investigated with the help of two Lummer plates of Quartz and Hilger's 3 metre spectrograph with interchangeable optical system of quartz. The region between 3350 to 2750 has been investigated for the first time.

(8) *Fine Structure of the Spectrum Lines of Zinc arc in vacuum and the energy-levels of Zinc :* (Philosophical Magazinc, London, Vol. XII, 1931).

In the work mentioned before, an error had crept in due to the light from the incandescent oxycathode of the lamp and this necessitated a re-examination of the work. In addition to the calculation of fine-structure, a term-scheme of Zinc energy-levels has been set up.

(9) *Hyperfine Structure of Spectrum Lines of Silver Arc in the Visible and the Ultra-Violet regions:* (Indian Journal of Physics, Calcutta, Vol. VI, 1931).

18 Lines of the Silver arc-spectrum have been investigated for hyperfine-separations. The source of light has been the same as has been employed previously and the same two Quartz Lummer-plates have been used in this case. Out of the 18 lines, only two have been found to possess structure and the rest are sharp and simple. 9 lines in the visible and the ultra-violet regions have been investigated for the first time.

(10) *Hyperfine Structure of Spectrum Lines of Lead Arc in the Visible and the Ultra-Violet regions:* (Philosophical Magazine, London, Vol. XII, 1931).

This is an extension of the authors' work on the fine-structure of spectrum lines. 14 lines lying in the ultra-violet region between 3750 to 2550 have been investigated for the first time and only three lines have been found to possess satellites. A term scheme has also been worked out for the lead atom. Two Lummer plates made of quartz have been used in conjunction with a 3-metre Littrow type Spectrograph.

(11) *Hyperfine Structure of Arc Lines in Vacuum of Bismuth in the Visible and the Ultra-Violet regions—Part I:* (Philosophical Magazine, London, Vol. XIV, 1932).

The source of light was the same as has been used in the previous investigations by the authors. In all 13 lines of the Bismuth arc spectrum have been investigated all of which have been found to possess structure. In the absence of a suitable source of light, crossed plates could not be used, but the Lummer patterns as given by the two quartz Lummer plates have been correlated and the correct structure has been successfully found out. The results agree fairly with those of other workers.

(12) *Hyperfine Structure of Arc Lines in Vacuum of Bismuth in the Visible and the Ultra-Violet regions—Part II:* (Philosophical Magazine. Vol. XIV, 1932).

Based on the results of the previous paper, the authors have worked out hyperfine-separations of different lines of Bismith and the term schemes of various levels of Bi-atom have been given. Out of the 10 Bi-levels 7 have been resolved and 3 remain unresolved.

D. B. Deodhar.

(1) *New Bands in the secondary Spectrum of Hydrogen:* (Philosophical Magazine, September, 1928).

An investigation, by the author, of the yellow region of the spectrum of hydrogen on the basis of intensity distribution led to the discovery of seven band groups with P. Q and R branches for each group. These groups co-related about 125 lines of the spectrum. The initial and the final states of the molecule and the calculations of the moment of inertia from the band data showed that the band lines involved in the groups were due to an excited hydrogen molecule.

(2) *A note on Raman lines in the Spectrum of Hydrogen:* (Nature, May, 1929).

There appeared a possibility of co-relating many weak lines of the hydrogen spectrum as lines due to Raman effect and the rotational state of the molecule of hydrogen as calculated on this basis seemed to favour this view.

(3) *Raman Effect und Wasserstoffspektrum:* (Zeitschrift fuer Physik, Vol. 57, 1929).

A few weak lines in the secondary spectrum of hydrogen were observed to be associated with Raman Effect. A systematic study of such lines was made and a large number of

Raman lines associated with the Balmer series were correctly picked up from the wavelength tables. The intensity rule connected with the Stokes and anti-Stokes lines was also quite clear for the observed lines.

(4) *New bands in the Secondary Spectrum of Hydrogen. Part II :* (Philosophical Magazine, January, 1930).

This contribution deals with another system of seven band groups having a structure similar to that in the first part, published in 1928. The groups belong to the blue region of the spectrum, and in them also about 120 lines are co-related.

(5) *New bands in the Secondary Spectrum of Hydrogen. Part III :* (Philosophical Magazine, December, 1930).

This paper deals with a system of seven bands discovered by the author in the violet region of the spectrum. The discovery of this system showed that the final moments of inertia of the yellow, blue and the violet groups were the same while the initial moments of inertia corresponding to these various groups were different from each other. Thus the yellow, blue and the violet band groups appeared to be interrelated as the final states of the molecule were the same throughout.

(6) *A note on " Life of after-glow " in silica discharge tubes :* (Nature, March, 1931).

A very interesting phenomenon of the after-glow in discharge tubes was observed which lasted for more than an hour after the discharge tube was disconnected from a small induction coil with which it was excited just for two minutes. Usually an after-glow is known to last for a minute or so. Such a long life of the after-glow was discovered for the first time.

(7) *Spectroscopic study of the after-glow in discharge tubes :* (Indian Science Congress, 1932).

Further investigations were started on the after-glow with the help of a spectrograph. The intensity of the glow being weak very long exposures were to be given. An exposure of about 48 hours brought out a banded spectrum in the ultra-violet region in the neighbourhood of λ 3300. Its details could not be studied owing to faintness. Still longer exposure are called for.

D. B. Deodhar and S. K. Dutt.

(8) *On the Study of the Spectrum of Oxygen under different conditions of excitation* : (Philosophical Magazine, November, 1929).

The spectrum of hydrogen has been studied by the authors at a pressure of 0·2 to 0·3 mm. in Geissler tube and in a special type of quartz discharge tube. A striking differential behaviour in the nature of the two spectra was noticed. Further, a strong band head was observed in the neighbourhood of λ 4500. The structure of the band is being further studied with the help of a larger spectrograph. The band under investigation was discovered by the authors for the first time and it is believed to be definitely an oxygen band.

CONTRIBUTIONS BY RESEARCH FELLOWS COMMUNICATED BY **D. B. Deodhar :**

A. C. Banerji :

On the Peculiarities of Colour Variations in the Glow of Hydrogen under the conditions of low voltage and low pressure : (Indian Science Congress, 1932).

A special type of discharge tube was prepared and the discharge in hydrogen striking at different voltages and pressure was found to glow with different colours. A particular colour was always typical for a particular voltage and pressure.

The spectrum of the glow of a particular colour showed a prominence of lines in a certain region of the spectrum, weakening at the same time other lines of the spectrum. A spectrum plate corresponding to the glow with another colour brought into view quite a different group of lines as compared with the rest of the spectrum. This differentiation has enabled the author to establish regularities for many lines of hydrogen which were not known to be related so far.

Satyendra Nath Ray.

Papers omitted in the "Abstract of Publications by the members of the University, 1921—1927."

(1) *Isentropic Coefficient of Expansion* · (Physical Review, XV, January 1920. Translated in full, with diagram, into Journal de Physique).

(2) *A Note on the Equivalent Shell of a Circular Current:* (Philosophical Magazine, 39, January, 1920).

(3) *On Some Significant Relations in the Quantum Theories of Spectra.* (Nature, August, 1922).

(4) *On a Quantum Mechanism in the Atom:* (Lucknow University Journal, May, 1925).

(5) *Bemerkungen zur Arbeit von Yu Chen Yang "Ueber Messungen von Millikan's Kondensator":* (Abstracted by R. de Mallemann in Journal de Physique, 143, D, 1926).

(6) *On High Values of Wave Lengths obtained with Fresnel's Bi-Prism:* (Journal of Scientific Instruments, 1925).

(7) *Silver Deposit on Parallel Plates:* (Journal of Scientific Instruments, 3, 386, 1926).

(8) *Action of Wimshurst Machine:* (Journal of Scientific Instruments, 1926).

(9) *Progressively High Values of e/m obtained with a Thomson Vacuum Tube:* (Journal of Scientific Instruments, 379, August, 1926).

(10) *Apekshik tatva anusare Jar o Vidyuter Samparka:* (Bengali Literary Conference, Easter, 1925, "Uttara", 1925. Translated into Hindi in "Madhuri", 1926, by Mr. Hrishikesh Trivedi).

(11) *On the Possibility of the Existence of the Sub-Electron:* (Proc. Indian Science Congress, 1926).

(12) *On the Correct Significance of Dr. J. Mattauch's work on the Experimental Determination of the Law of Resistance:* (Proc. Indian Science Congress, 1926).

(13) *Atomicity of e/a from Zurich data from Baer and Yu-Chen Yang.*—(Proc. Indian Science Congress, 1926).

Papers continued:

(1) *Ueber eine Kolloide Theorie des van der Waals'schen Gases:* (Kolloid Zeitschrift. 57, 259-66, 1931).

Cf. C. A. 25, 1419, 2888, 2910, 5602. Gas mols. are electrically charged particles with an elec. nucleus surrounded by a shell with an opposite charge. The mol. wts. are the masses of different substances with the same charge. For ideal gases whose mols are not deformed, the model gives $pv = MRT$. The Avogadro no. is the no. of these mols. per cc. and is not independent of the form and compn. If mols. of different gases possess the same charge, and the position of the charges for the different gases, by change of mols., is exactly the same, the van der Waals' ratio a/b is a real constant. [Abstracted by Arthur Fletscher, p. 1172, in Chemical Abstracts, 1932]. (See also, Journal de Physique, 1932; British Chemical Abstracts, 1932; Science Abstracts, 1932; and Chemisches Zentralblatt, 1932).

(2) *Ueber einen physikalischen Faktor in der Liesegang-schen Erscheinung:* (Kolloid Zeitschrift, 44, 277-279, 1928).

An expression is derived which gives the relation between the density and the height of a colloidal suspension. According to theory there are three possible heights for certain densities. This is considered to be the primary cause of the periodicity in Liesegang rings. [Abstracted by E. S. Hedges in British Chemical Abstracts, A. 587, 1928.] (See also Science Abstracts, 1928; Journal de Physique, 1929; Chemical Abstracts, 1928; Chemisches Zentralblatt, 1928.)

(3) *Ueber Photophorese in Fluessigkeiten:* (Kolloid Zeitschrift, 44, 277, 1928).

Using the term photophoresis for the motion of small particles, both away from the source of light (positive light pressure) and towards the light (the unexplained negative light pressure of Ehrenhaft, see Abstract 1085, 1918), the author describes experiments on the motion of particles in liquids. He first observed that the cement used for joining glass windows was streaming in the water (towards the light), and he studied the effect in emulsions. The direction of streaming is always parallel to the beam of the arc lamp, and independent of the shape of the cell, but may be radial close to the walls of the cell. The movement may be positive or negative and may change for the same substance in the course of an experiment. It is the same in emulsions of oil in water as in emulsions of water in oil. Gas evolution disturbs the phenomena in sulphur suspensions prepared by precipitating sodium thiosulphate with sulphuric acid. [Abstracted by H. B. in Science Abstracts, 2361, 1928.] (See also British Chemical Abstracts, 1928; Chemical Abstracts, 1928; Journal de Physique, 1929; Chemisches Zentralblatt, 1928).

(4) *Ueber die Struktur der von Millikan und Mattauch untersuchten Oel und Quecksilbertropfen:* (Kolloid Zeitschrift, 44, 186-188, 1928).

Mattauch (experimentally) proves that the drops of Millikan have a volume which increases when the pressure of the surrounding gas decreases from 760 to 10 mm. of Hg. According to the author these "drops" should be *hollow* spheres constituted of charged molecules of which the volume varies to maintain equilibrium between the pressure of the gas enclosed in the interior and that of the gas in the exterior. According to the author, this hypothesis contributed to explain the ratios *m/e* and *e/a*. [Translated from the Abstract by G. Malfitano in Journal de Physique, 9, 617, 1928]. (See also British Chemical Abstracts, 1928; Chemical Abstracts, 1929; Chemisches Zentralblatt, 1928).

(5) *Die Feinstrukturkonstante als eine numerische Konstante:* (Die Naturwissenschaften, 15, 408, 1927).

If one admits it, as Jeans has remarked, that $hc/2\Pi = (4\ \Pi e)^2$, we find that the constant α of Sommerfeld is a pure number. [Translated from the Abstract by R. Moenn in Journal de Physique, 9, 787, 1928]. (Also British Chemical Abstracts, 1928; Chemical Abstracts, 1927; Chemisches Zentralblatt, 1927).

(6) *Ueber den Durchgang des elektrischen Stromes durch eine Cooper-Hewitt Quecksilberlampe:* (Zeitschrift fuer Elektrochemie, 35, pp. 89-93, February, 1929).

The unidirectional conductivity of the Cooper-Hewitt Mercury Lamp, is accounted for by the influence of residual trace of gas which are absorbed by the mercury to make the liquid state possible. The intrinsic charge on the mercury atom with the binding material of oppositely charged gaseous molecules forms a hypothetical compound Hg Z. On applying a sufficiently great negative potential to the mercury, the negatively charged Z atoms are repelled and finally escape as bubbles from the surface of mercury and migrate, with a surrounding shell of mercury, to the anode. After liberation

of the charge the mercury is repelled from the anode and returns, surrounded by an adsorbed layer of gas, to the cathode, when the process is repeated. The fall of the density of mercury vapour away from the cathode and that of the gas from the anode follows an exponential law. On reversing the polarity of the electrodes the disturbance of this distribution leads to the transient small current that is observed, while the repulsion of the gas from the electrode in the gas space, which is now cathode, leads to a complete vacuum in its neighbourhood, whence the glow and the conductivity cease. The phenomena which this hypothesis accounts for include the electrical "distillation" observed in mercury lamps, the occasional fall of conductivity on prolonged operation which is restored by standing and the luminosity which has been observed during the operation of the mercury diffusion pump. This hypothesis is further in accordance with the theory of Compton that the greater part of the glow discharge arises from excitation of neutral atoms by electron impacts. An expression is derived on the basis of the work of repulsion to give the relation between minimum arc voltages and the size of the gaseous aggregates or atoms. [Abstracted by J. N. Pring, in Science Abstracts, 2261, 1929]. (See also British Chemical Abstracts, 1929; Chemical Abstracts, 1929; Chemisches Zentralblatt, 1929).

(7) *Das Ohm-Fouriersche Gesetz der Leitung:* (Zeitschrift fuer Elektrochemie, 34, pp. 733-556, November, 1923).

An interesting theoretical discussion of the meaning of Ohm's Law which was originally read at the Indian Science Convention in Calcutta in December 1919. The author calls attention to the help towards the understanding of the nature of electrical conduction from the analogy of Fourier's form of the law of conduction, and discusses recent theories of electronic conduction [Abstracted by J. J. Stewart in the Science Abstracts, 1966, 1929.] (See also British Chemical Abstracts,

1929; Chemical Abstracts, 1929; Chemisches Zentralblatt, 1929.)

(8) *Eine Notiz ueber die Hittorfsche Auffassung der Elektrolytischen Stromleitung.* (Zeitschrift fuer Elektrochemie, 35, pp. 469-470, August, 1929).

The only experimental fact in proof of Arrhenius's already dissociated molecules is the weak current which passes under the smallest *e. m. f.* below the critical *e. m. f.* required for the dissociation of the molecule. The required brief current is provided by the drift of the charged salt *molecules* in the electric field. Hittorf's theory does not provide for the inequality in the ion-velocities. But it is not necessary to assume that the ion-velocities are the same throughout the course. If we assume them, as measured, to be initial velocities only, the sole condition for their reaching equal average values is the constancy of the ratio e/a. [Abstracted by A. Daniell, 1251, in Science Abstracts, 1930.] (See also British Chemical Abstracts, 1929 Chemical Abstracts, 1929, Chemisches Zentralblatt, 1929).

(9) *Eine Bemerkung ueber die Konstanten der van der Waals' schen Gleichung.* (Kolloid Zeitschrift, 56, pp. 159-166, August, 1931).

The van der Waals' constants for a large number of gases are tabulated and the ratio a/b evaluated. The probability that all the experimentators would find that a/b is practically the same even when a and b deviate appreciably, indicates no mere chance. When a great deviation of a/b occurs, a specific atomic character is denoted. The explanation of the general constancy of a/b and of the characteristic deviations is to be found in the colloidal theory of gases. [Abstracted by H. H. Ho. Science Abstracts, 1931.] (See also British Chemical Abstracts, 1931, Chemical Abstracts, 1931; Chemisches Zentraiblatt, 1931.)

(10) *Ueber Konstante Strœme, die mit Elektrolytischen und Thermoelektrischen Strœmkreisen erhalten werden:* (Zeitschrift fuer Elektrochemie, 36, 425, July, 1930).

(i) A column of $CuSO_4$ solution in a vertical tube in which above and below, Cu-electrodes were immersed, was connected to a galvanometer. A current was obtained which maintained itself for days. On inserting extra resistance into the current circuit (up to 11200 ohms) the galvanometer deflection remained constant.

(ii) A galvanometer showed with a circuit of two solid thermo elements placed in the air of the room a current even when the junctions were at the same height so that no temperature difference existed. The insertion of the extra resistance has no influence. [Translated from the Abstract by Kleamm in Chemisches Zentralblatt, 2494, 1930.] (See also British Chemical Abstracts, 1930 ; Chemical Abstracts, 1931.)

(11) *Ueber den Elektrolytischen Widerstand bei Wechselstrœmen:* (Zeitschrift fuer Elektrochemie, 36, 545-550, August, 1930).

In the case of the cataphoretic conduction, in the case when *e.m.f.* is not constant, the current is proportional to dx/dt. and is given by the equation :

$$C = Ne\,\frac{dx}{dt} = Nep\,\frac{eE_0/m}{\alpha^2/m - p^2}\cos pt$$

The resistance is inversely proportional and of the form

$$R = {}^1Ne^2 \cdot \left[\left(\alpha^2 - mp^2\right)/p\right] = \left(\beta - p^2\right)/\alpha \cdot p$$

This represents a hyperbola with the origin as centre of which the asymptotes are $p = o$ and $p = \beta$ $R = 0$. The zero current corresponding to $p = 0$, corresponds to no current being

obtained when no vibrations of the solute particles take place. For very slow motion of the ions the motion obeys the law for colloidal particles moving in a viscous medium, *viz.*, $v = B F$. This law is derived from a (velocity)^2 law of resistance, and the existence of a limiting value of the velocity, which is only reached after an infinitely long interval of time has elapsed from the starting of the motion. The author, after setting forth the *physical* inadequacy of modern mathematical methods of the solution of Differential Equations, seeks to explain certain unexplained points of electrolytic conduction through physical considerations. [Translated from the Abstract by Aschermann in Chemisches Zentralblatt, 1957, 1930.] (See also Science Abstracts, 1931; British Chemical Abstracts 1930; Chemical Abstracts, 1932.)

(12) *Ueber eine theorie der Veræenderlichkeit der Oberflaechenspannung mit der Dicke und dem Querschnitt der Glasplatten, gemessen mit dem Searleschen Tensiometer:* (Kolloid Zeitschrift, 56, 49-51, 1931).

The theory proposed consists in assuming that the elements of the glass plate represent small particles of intrinsic positive charge and the surface of water represent particles with intrinsic negative charge. Consequently the measure of the phenomena can be made according to Coulomb's law, taking into account the contour of the plate causing an irregularity in the cushion of water which remains adhering to the plate when being pulled out. [Translated from the Abstract by G. Malfitano in Journal de Physiqe 3D, 282. 1932.] (See also Science Abstracts, 1931; British Chemical Abstracts, 1931; and Chemical Abstracts, 1931).

(13) *Oberflæchenspannung beim Vakuum:* (Kolloid Zeitschrift 50, pp. 19-21, January, 1930).

An attempt is made in the present work to confirm experimentally the theoretical deductions of an earlier paper

(See Abstract 2552, 1928) wherein it was deduced that the height of a liquid in a capillary must be zero when measured in a vacuum. [Abstract by J. Kershaw, 546, in Science Abstracts, 1930]. (See also British Chemical Abstracts, 1930; Chemisches Abstracts, 1930 Chemical Zentralblatt, 1930).

(14) *Eine Theorie zu den Beobachtungen von Schultze ueber die Fluessigkeitshœhe zwischen parallelen Platten*. (Kolloid Zeitschrift, 59, 280-283, 1932).

The observations of Schultze (A. 1931, 679) is explained in terms of the colloidal theory of surface tension (A. 1928). [Abstract by E. S. Hedges in British Chemical Abstracts, 803, 1932.] (See also Science Abstracts, 1932; Chemical Abstracts, 1932; Chemisches Zentralblatt, 1932).

(15) *Generalisation of the Virial of Clausius:* (Acad. Polonaise Sci. et Lettres, Bulletin 4-5 A. April-May, 1925).

In the kinetic theory of gases the virial of Clausius is given by $\frac{1}{2} m c^2 = -\frac{1}{2} \sum \left(x X + y Y + z Z \right)$, where c is the velocity of the individual moelcule, and X,Y,Z the components of the force acting on that molecule. It is pointed out that (1) the result is not, as is usually assumed, independent of the origin of co-ordinates, but that the origin should be taken as the centre of the mass of the volume of gas; (2) force X and co-ordinate x have opposite signs. It is usually assumed apparently that Gauss's transformation can be easily applied, that the pressure is the same at all points of the containing vessel. The author on the other hand, assumes that the pressure may vary from point to point with distance from the walls according to an exponential law of the form $p = p_0 e^{-kh}$. With this assumption of variability of pressure

and density inside the volume of a gas the relation is rigorously obtained;

Virial of External Forces $= 3/2\ \pi v$.

where π is the average pressure and is defined by the relation

$$\pi = \frac{1}{v} \iiint p\, dx\, l\, y\, dz$$

[Abstracted by T. Barratt, in the Science Abstracts, 1123, 1930]. (See also British Chemical Abstracts, 1929; Chemical Abstracts, 1931.)

(16) *Ueber eine Kolloide Theorie der Oberflaechenspannung:* (Kolloid Zeitschrift, 45, 9-12, 1928).

After discarding the notion of electrical neutrality of matter to start with, a theory of surface tension is developed according to which the force of cohesion is attributed to a distribution of opposite charges similar to that in Bragg's crystal structure. The assumption of such a colloidal, or as it were a crystalline, structure of the surface permits the explanation of the properties of surface layers. The author brings out how for such an electrical model the rise of liquids in capillaries and the mode of action of the capillary electrometer can be explained. [Translated from the Abstract by Leszynski in Chemsiches Zentralblatt, 227, 1928.] (See also Science Abstracts, 1928; Chemical Abstracts, 1928.)

(17) *Ueber die Taetigkeit des Wehnelt Unterbrechers und der Krystallzeiter:* (Zeitschrift fuer Elektrochemie, 36, 425-427, Juli, 1930).

Considers the " quasi-crystalline " structure of solutions due to the cataphoretic charges on the particles of the solute and those of the solvent. The forces between the two sets of particles are of the same nature as those between the particles

of a crystal, and the author shows that if there is an electric field a periodic vibration of the centre of gravity of the dissolved mass will result; in other words, two continua are present one of which oscillates with respect to the other. There is thus an oscillatory cataphoretic current, and on this is superposed a dissociation current in one direction. If the absolute maximum of the oscillatory current is equal to the constant value of the dissociation current, the resultant current will be in one direction only, and an interrupted current will result. This is apparently what takes place in the Wehnelt Current Interrupter, and explains the rectification produced by the crystals. [Abstracted by H. N. A. in Science Abstracts, 314, 1931]. (See also Chemisches Zentralblatt, 1930; British Chemical Abstracts, 1930; Chemical Abstracts, 1931).

(18) *Die Geschwindigkeit des Durchganges von Wasser durch eine halbdurchlaessige Wand infolge des osmotischen Druckes:* (Zeitschrift fuer anorganische Chemie, 182, 351-352, 1929)

An expression for the rate of osmotic flow of solute through a semi-permeable membrane is derived." [Abstract by H. F. Gillbe in British Chemical Abstracts, 1378, 1929]. (See also Chemical Abstracts, 1929; Chemisches Zentralblatt, 1929).

(19) *Ueber Anziehung und Abstossung zwischen den Platten in Schultze's " Gorge Methode:"* (Kolloid Zeitschrift, 60, 77, 1932).

Theoretical. The effect described (this volume, 112) is independent of the geometrical form but not of the material of the plates. [Abstract by E. S. Hedges, 909, 1932, in British Chemical Abstracts]. (Also Chemical Abstracts, 1932, Chemisches Zentralblatt, 1932).

(20) *A Note on Isotopes :* (Proc. Indian Science Congress, 1928).

It is postulated that the value of e is 0·005 of that determined by Millikan. [Abstracted by Chemical Abstracts from I. S. C. P. in B. C A.].

(21) *Avogadro's Number and "Mean Free Path":* (Proc. Indian Science Congress, 1928).

If the usual expression $\lambda = 1/\sqrt{2}\ \pi\ N\ \sigma^2$ is correct, the mean free path is not intimately related to volume, pressure, temperature or entropy ; since Avogadro's Number is approximately the same for different atoms, the expression $\lambda = \left(\sqrt[3]{\frac{N}{3}} - \sigma \right)$ is proposed. [Abstracted by Chemical Abstracts from I. S.C. P. in B. C. A.].

(22) *Avogadro's Number and Electronic Charge :* (Proc. Indian Science Congress, Chemical Abstracts, 2910, 1931].

(23) *Imaginary Character of Mass Equivalent of Electricity:* (Proc. Indian Science Congress, Chemical Abstracts, 2910, 1931).

(24) *Longitudinal Wave along a Rod :* (Proc. Physical Society 40, 177, June, 1928).

That longitudinal waves are propagated with the same velocity for all wave-lengths only when the waves are "geometrically similar" is here proved in exactly the same manner as for ether strings, air columns or transverse waves along stretched strings. The expression for the velocity is of course different. (Also Journal de Physique, 1929).

(25) *Transverse Wave Velocity along a Solid :* (Proc. Benares Mathematical Society, 1929).

The necessity of geometric similarity of all waves for the constancy of wave velocity is proved.

(26) "*Ghost Lines*" *caused by an Absorbed Layer on Grating Surface:* (Proc. Indian Science Congress, 1931).

Report of physical and physiological observations. (Reference in Chemical Abstracts, 1915, 1931).

(27) *Ueber die hoehere Werte von e/m, erhalten mit einer Thomson Vakuum Roehre:* (Zeitschrift fuer Elektrochemie, 35, 209-11, April, 1929).

In a Thomson Vacuum Tube a continuous rise of e/m in three month's time from $1{\cdot}8 \times 10^7$ to $4{\cdot}10^7$ *e. m u.* was obtained as the tube went on hardening. (Journal of Scientific Instruments. 3,379, 1926). The author seeks to explain this rise by assuming a complex ion-like structure of the so-called "electron," of which the character varies with condition of the vacuum in the tube.

The author interrelates his results with the results of Aston by the assumption that the latter can be explained by taking the value of e as 1/200 of its accepted value of $4{\cdot}77 \times 10^{10}$ *e. s. u.*

In continuation of his earlier experiments he has succeeded in obtaining with a Thomson tube a value of e 80 times the standard value. [Translated from the Abstract by Leszynski in Chemisches Zentralblatt, 2854, 1929]. (Also Chemical Abstracts, 1930; British Chemical Abstracts, 1929).

(28) *Melde's String Vibrated by a Rotating Pulley:* (Nature, 129, 202-203, 1932).

A cord is passed over a pulley which is rotated. Vibrations of the cord are then easily excited. With a cord of 2 m. the fundamental gives an amplitude of 3·5 cm, the second harmo-

nic an amplitude of 2 cm. and the third harmonic an amplitude of 1 cm nearly. (Vibration longitudinal). [Abstract by L. Bruningshaus, in Journal de Physique, 3D, 469, 1931].

(29) *Matter and Electricity in the Theory of Relativity:* (Lucknow University Journal, February, 1925).

(See Abstract by F. Wolfers in Journal de Physique, 3, 87, 1927).

(30) *On the Failure of Fourier's Analysis for strings and pipes except under Quantum Conditions:* (Proc. Benares Mathematical Society, 15-21, 1924). (Abstract by L. Bruningshaus in Journal de Physique. 9, 629, 1928).

(31) *Back Wave in Wave Motion:* (Acad. Polonaise, Sci. et Lettres, Bulletin. 4-5, A. 229-232, April-May, 1929).

A brief discussion of the anomalies which arise when simple treatments of wave motion are applied to physical examples in which the speed of propagation depends upon the amplitudes, so that the wave length depends upon the distance from the origin.[Abstracted by W. H. George, in Science Abstracts, 1129, 1930].

(32) *A Note on the Compton Effect:* (Proc. Indian Science Congress, 1927).

It is submitted that the effect is only a doubling,—or tripling ?—of some lines in the X-ray region. They have analogues in other wave-length regions, *e. g.* in " Un nouveau phenomene en optique " (Journal de Physique, VI, 305 and 354), and the earlier work of Rubens on " Reststrahlen ". An expression similar in form to that of Compton is given from a theory of photoelectric phenomena given by the author in Zeit, f. phys, 33, 231, 236, 1925. (Also Chemical Abstracts, 2914, 1931).

(33) *Change of Wave Length by transmission through a thickness of transparent glass:* (Proc. Indian Science Congress, 1927).

As early as 1924 the author from theoretical considerations sought to obtain the evidence of change of wave-length due to passage through a length of glass. It was first tested with a constant deviation spectrometer but without success. Rhodamine and methyl violet filters were then attempted with the Michelson interferometer with very satisfactory results. During attempts to photograph this effect, as well as the Bhar effect, by making it stationary by the arrangement described in Journal of Scientific Instruments, August, 1926, p. 386, the silvering of the half-silvered plate was found to have entirely disappeared. After some time, when the plates were despatched to Adam Hilger for resilvering, the interferometer was fitted up with Fabry and Perot interferometer attachments. With the high resolving power thus obtained the effect first sought to be found with the wave-length spectrometer was again sought. A small but distinct break with parallel horizontal fringes was obtained when a glass cube of 2 inch side was put behind the plates so as to cover half the field of view, A. 50.

(34) *On the possibly spurious character of the "Fine Structure" of lines and of the "Continuous Spectrum" of Hydrogen:* (Proc. Indian Science Congress, 1927).

The result mentioned in Abstract 50 has obviously a bearing on the "fine structure" of lines. In the Lummer and Gehrcke plate, successive pencils travel through successively increasing lengths of glass and should possess a specific value of λ each. The fine structure may be nothing more than difference in the wave-length of the different pencil elements revealed by the resolving power of the optical system.

An elementary investigation is made showing that the separation of the fine structure elements would increase rapidly with decrease of wave-length. This would make the

study of fine structure in the ultraviolet region extremely profitable. The recorded results, however, do not seem at first to justify this hope. Theoretical considerations and experimental evidence are submitted for explaining this experimental discrepancy.

The result mentioned in Abstract 49, (Conversion of Line Spectrum into a Continuous One, Phys. Zeit., 1926) may have some bearing on the continuous spectra of elements. The glass wall is an absorbing medium, and certain specific lines, by the passage through the glass walls themselves, or through the material of the prism, may be converted into a continuous spectrum.

Without in any way questioning the explanations extant of these two phenomena, it is submitted that the probability of their being "manufactured" in the way indicated here is not completely ruled out of order, A. 51.

(35) *A Note on the Simple Periodic Motion :* (Proc. Indian Science Congress, 1928).

The solution of the equation $\frac{d^2y}{dt^2} = -u^2y$ is given as a periodic motion of period $T=\frac{2\pi}{u}$. Writing the equation in the form $\frac{d^2y}{dt^2} = -(nu_n^2)y$, the simple periodic motion $y = na \sin u_n t$ of period $\frac{2\pi}{u_n}$ can be seen to satisfy the physical condition of an S. H. M. *viz*, $\frac{d^2y}{dt^2} = -u_n^2 y$. Therefore, along with the period of $\frac{2\pi}{u_n}$ other periods are possible given by the relation $\nu_n = \nu_0 \sqrt{n}$

Again, as energy is proportional to the square of the product of a and $> \pi^2 {}^2_a V_n = n\pi^2_a {}^2_n \nu_0{}^2$ where n is an integer. The energy of the vibrating particle is therefore atomic in structure.

(36) *Note on the Discharge of an Electroscope:*— (Proc. Indian Science Congress, 1928).

(Copies of paper handed to Prof. A. H. Compton and sent to Dr. W. Kolhoerster in February 1927). It is shown that the discrepancies between the results of Millikan and Kolhoerster can be completely explained if we remember that the potential of the enclosure is varying with height during ascent and descent according to an experimental law submitted by the author to the Indian Science Congress, Benares. (Zeit. f. Phys , 33, 48-52, 643-645).

(37) *Longitudinal and Transverse Wave Velocities in a Solid:* (Proc. Indian Science Congress, 1928).

Both these waves can be easily proved to have velocities which vary with amplitude. This affects the treatment in quantum theory of the problem of variation of specific heat of solids with temperature while giving a simple classical dynamics explanation of it.

(38) *On Multiple Reflection of a Wave between Two Parallel Walls distant* $n(\lambda/2)$ *apart:* (Proc. Indian Science Congress, 1929).

It is shown that such reflection will give rise to multiplicity of closely spaced equidistant nodes on two sides of the position of exact adjustment. This will give a simple explanation of striations in Kundt's tube, vacuum discharge tubes, and fine structure with interferometers of a certain type, etc.

(39) *On a Supposed Failure of Maxwell's Theory of Tubes of Force* : (Proc. Indian Science Congress, 1929).

Poincare has pointed out the failure of Maxwell's stresses for a tube of force which is reproduced in Starling's " Electricity and Magnetism." The analogy is, however, a very specific one, *viz.*, of a rectangular bar of solid acted on by forces at right-angles to the faces and the strains taking place parallel to the forces. A *reductio ad absurdum* is supposed to be obtained in the result that the value of the " electric displacement " is found infinite when there is no electric intensity. If we notice, however, that the " electric displacement " has the dimensions of a surface density, and drop the specific analogy chosen, it would be found that the model is quite workable. The infinite value of the electric surface density can be seen to be the result of the infinitely large value of the Avogadro's Number for the " ether gas " built up of infinitely small electric charges. The displacement, is not parallel but perpendicular to the lines of force. The displacement is of the nature of the number of particles, originally uniformly distributed in space, concentrating in layers perpendicular to the lines of force, while the linear density, parallel to the lines of force, decreases in consequence. If any analogy in elasticity is sought, we shall find it in a flat spiral that would coil up when elongated, the increase of surface density being attended with increase of distance apart of coils."

(40) *On the Atomicity of Electric Potential of Colloidal Silver in the Recent work of O. Trauner in Vienna* : (Proc. Indian Science Congress. 1929).

From Trauner's observations it is shown that the value of e/a for the different particles exhibit a law of atomicity.

(41) *On the Atomicity of* $d\lambda$ *in the Hyperfine Structure of Cadmium Lines in the Recent work of Dr Analisse Schrammen* : (Proc. Indian Science Congress, 1929).

From new lines in the hyperfine structure necessity of postulating of new sub-levels is claimed by Dr. Schrammen. The present writer shows an atomicity in the values of $d\lambda$ for the different lines as indicated in the theory submitted to the Lahore Session of the Congress, 1927.

(42) *On X-Ray and Visible Spectrum Analogies:* (Proc. Indian Science Congress, 1929).

In seeking analogies in X-rays and visible spectrum phenomena certain outstanding points seem neglected. There is no " practical " analogue ; *e. g.*, of powdered crystal and rotating crystal methods in the visible regions. As no spectroscopist working in the latter region, in the writer's knowledge, works with a prism of powdered glass or quartz, or rotates his prism periodically during the exposure, or thinks of even extending mathematically, the analysis to the visible and ultraviolet regions, the present writer doubts if the interpretation of the results in the X-ray region is entirely correct.

The fact of crystalline and amorphous solids, and even solids and liquids behaving in the same manner in the X-ray phenomena should not be utilised to build up a " solid " structure of liquids, when in the history of Physics the luminiferous ether has been sent to the limbo of exploded theories for doing the same.

Again scattering of luminous waves by solids and liquids investigated by Professor Raman militates against the space-lattice structure of Bragg and Laue. If the " atomic planes " be billowy for long luminous wave-lengths, it is difficult to conceive how these very atomic planes are stationary for the infinitely shorter X-ray wave-lengths to be able to give the reflections in the various directions of Bragg's analysis.

It appears in the amorphous substance, the rotating crystal, powdered crystal and the liquid, we have an X-ray analogy

of a well-known principle of physical optics, according to which a random distribution of identical difiracting patterns gives us an intensified edition of the diffraction due to a single one of these. This is why crushing, rotating, or liquefaction makes little difference, or if any, a difference for the better. At any rate the X-ray diffraction phenomena admittedly look very much like halos of physical optics.

(43) *Transverse waves in ether gas:* (Proc. Indian Science Congress, 1930).

From the variability of Avogadro's Number, (Zeit.f.phys. Chem. 128, 182, 1927), it is shown that if ether is "excessively fine-grained," it can carry transverse light waves, while behaving as a perfect fluid for astronomical motions for all practical purposes.

(44) *Longitudinal Tremors in Thomson's Super-Dispersive medium:* (Proc. Indian Science Congress, 1930).

From Sir J. J. Thomson's investigation it is shown that a super-dispersive medium is capable of carrying longitudinal waves. It is believed that this explains the Kothari and Gogate results (Indian Journal of Physics, August 1929), and the explanation furnishes a simple mathematical derivation of Yagi's formula.

(45) *Ueber den Form der Hartmannschen Formel:* (Zeitschrift fuer Instrumentkunde, 51,1931).

In spectral photography one utilizes the formula of Hartmann $\lambda - \lambda_0 = \frac{a}{x - x_0}$, determining the constants , a, λ_0, x_0 with the aid of their known wave-lengths. For $x = x_0$ one obtained $\lambda = \infty$. Consequently the formula does not represent actual results. It is certain that the formula is necessarily, only applicable (1) for sufficiently large distances from x, and again (2) for a small interval of wave-length.

The inadequacy of the formula of Hartmann results also from the theory of errors, which leads to the relation :—

$$\frac{d\lambda}{\lambda - \lambda_0} = \frac{dx_0}{x - x_0} + \frac{da}{a} + \frac{x - x_0}{a} d\lambda_0$$

When one approaches x_0, the first term of the right hand expression becomes infinity. The author prefers the use of the relation of simple proportionality, $d\lambda = kdx$, for such ranges.

[Translated from Abstract in " Revue d'Optique," February, 1932, p. 81.]

(46) *Classical Derivation of Raman Effect :* (Proc. Indian Science Congress, 1930).

It is attempted to demonstrate that the Raman Effect is the obtaining of " combinational tones " in optics and that the quantitative results obtained are not against classical dynamics as presumed by Raman.

(47) " *Raman's Classical Derivation of the Compton Effect* ": (Proc. Indian Science Congress, 1930).

It is shown that the splitting up of into I_1 and I_2 as done by Raman (Indian Journal of Physics, III. 3, p. 361, 1929) does not give (1)a steady and (2) a variable effect at all, in as much as F occurs in both the components. It is easy to divide I_1 into two such parts, and this is done in the paper. It is shown that the really variable part so obtained, within a small percentage error, is identical with the so-called steady effect of Raman's analysis.

(48) *A Note on Stefan's Law:* (Proc. Indian Science Congress, 1930).

At the 1929 Congress experimental results of H. L. Tandan Ram Saran, and Brij Behari Lal were reported. The author believes the discrepancy is due to theoretical difficulties.

Stefan's law was, originally, an empirical formula in the manner of Newton and Dulong and Petit's law of cooling. It is shown that Denning's formula cannot be theoretically true. It is shown that in a Hohlraum the temperature cannot be constant unless the density of ether varies with coordinates. Experimental results of Mr. Ram Saran are given.

(49) *Shanti Swarup Sharma's Analogue of Wiedemann-Franz Law:* (Proc. Indian Science Congress, 1930).

S. S. Sharma, in autumn of 1926, drew the author's attention to the analogy between the thermodynamic relationship between the thermo-electric power and the specific heat of electricity and the similar relationship between latent heat and specific heats in thermodynamics. A theoretical explanation is given of this analogue.

(50) *A Note on Zeeman Effect:* (Proc. Indian Science Congress, 1930).

It is shown that the Zeeman effect should give us a continuous band instead of isolated lines as obtained. It, therefore appears the phenomena may be other than what we take it for (Copy sent to Professor W. Gerlach).

(51) *A Question of Relativity:* (Proc. Indian Science Congress, 1930).

Einstein presumes that the most careful observations have never revealed anisotropic properties in the terrestrial physical space, *i. e.*, a physical non-equivalence of different directions. If, however, a railway train travels north and south from Dehra Dun or Poona, it would, on account of the spheroidal shape of the earth, cause the moment of inertia of the earth to change and therefore alter the angular velocity of the earth. The mechanical energy changes will produce alteration in terrestrial electric and magnetic fields; explaining the latter and

furnishing relativists with the 'anisotropy' which they miss.

(52) *A Question of Geometry:* (Proc. Indian Science Congress, 1930).

On account of Gogate's paper, " A Serious Difficulty in Cotter's treatment of Quantum Phenomena ", Prof. Cotter has altered the treatment in the new edition of Preston's Theory of Heat, presenting Mr. Gogate with a copy of his book. It is submitted that the difficulty is only increased in the new treatment.

(53) *A Modified form of Denning's Apparatus for Determining Stefan's Radiation Constant:* (Proc. Indian Science Congress, 1931).

On replacing the silver two-anna bit at the centre of the hemispherical radiator by a hemispherical receiving surface concentric with the radiator, (radii 29·5 and 23·5 ohms. respectively) a value of the constant $5{\cdot}66 \times 10 \times 5\ 10^{-5}$ C. G. S. units was obtained.

(54) *On a Colloidal Theory of Matter:* (Proc. Indian Science Congress, 1931).

It is submitted that in (i) the Process of Titration, (ii) Raoult's Law, (iii) Suction through Semi-Permeable Membranes, (iv) Avogadro's Law, (v) Dulong and Petit's Law, (vi) Wiedemann-Franz's Law, (vii) Faraday's Law of Electrolysis, (viii) Aston's Isotopes, and (ix) the so-called Electron—all phenomena are capable of explanation without assuming that atoms have necessarily the same mass or size, and by assuming only that an element is settled by the value of the Faraday Ratio e/m.

(55) *The Physics and Physiology of Acoustics of Buildings :* (Proc. Indian Science Congress, (1931).

In spite of the training of architects in the acoustics of buildings according to the theory of Sabine and Jæger, the marketing of absorbent material for acoustic correction on a commercial scale, indicates a failure of the theory in so far as buildings designed in accordance with the theory do not give in practice the good acoustics expected.

Physiologically it is not at all clear why the period of reverberation tolerated for a big hall should be greater than that for a small one. It is shown that the proof of any such variation, within the limits of accuracy, does not exist.

Physically the theory assumes (i) that hearing is caused by scattered sound radiation, and not by direct rays, (ii) that volume density of energy is the same everywhere in the hall, and (iii) that the direction of speaking has no effect on the loudness perceived. Against these it is submitted that direct sound rays are responsible for audition, and a definition of " audibility " similar to that of " visibility " is proposed.

A quasi-quantum emission of sound is then physically and physiologically suggested which leads to a constancy of the period of reverberation.

(56) *On the Passage of a Charged Particle through a Double Array or ' Avenue ' of Alternately Positive and Negative Charges :* (Proc. Indian Science Congress, 1932).

It can be shown that the particle will move with its velocity alternately accelerated and retarded, or will travel with alternately positive and negative rotational velocity about its axis perpendicular to the plane of the avenue, according to the disposition of the charges in the avenue.

(57) *Planck's $h\nu$ as an Exchange Ratio*: (Proc. Indian Science Congress, 1932).

When a vibrating particle stops, owing to transfer of its energy to a medium, in which it sets up waves, it can be shown that if the wave velocity is constant the waves are geometrically similar and that before a vibration of the source stops, $k\nu$ or $h\nu$ wave-lengths in the medium shall be generated. One frequency of one particle is therefore equivalent to the same frequency in $k\nu$ or $h\nu$ shells of thickness λ in any exchange of energy between source and medium.

(58) *A Simple Parallel Plate Type of Apparatus for finding Radiation Constant*: (Proc. Indian Science Congress, 1932).

The Denning's apparatus for determining σ reported to the Nagpur session 1932, was further modified by making the areas of the radiating and receiving surfaces absolutely equal in a parallel plate condensor type of apparatus. The heater forms the bottom of a cylindrical vessel resting on the parallel plate below it, and thermally insulated from it by three cleats. Two methods of calculating the value of the constant were employed, one at any temperature before the final fixed temperature is attained, the other when, at the final temperature, equilibrium is attained between the heat gained from the radiator and the heat lost from the reciever's undersurface, by Newton's law of cooling. As the error in the two cases can be easily seen to be complementary and not independent of each other, a very good value of the constant is found by taking the mean of the results found by the two methods. This result differs from classical experimental values by less than 2 per cent.

(59) *A Theory of Catalytic Action*: (Proc. Indian Science Congress, 1932).

$\int dQ$ for a thermodynamcial cycle is not zero. It must

therefore mean that a change of state takes place of the working substance during the cycle. In this continuous change of state during successive cycles, the work done by the cycle can be utilised to help or retard a chemical reaction and the working substance would behave like a catalytic agent.

(60) *The Isentropic for a Substance obeying Grueneisen's Law:* (Proc. Indian Science Congress, 1932).

It is shown that for a substance for which the ratio of the coefficient of expansion to the specific heat is constant independently of temperature, it is not dQ/T but dQ itself that defines the change of entropy. The equation of the isentropic is derived.

(61) *Calorimetry with Volume of Solids with the help of Grueneisen's Law:* (Proc. Indian Science Congress, 1932).

Grueneisen's Law states—

$$(1/v)(dv/dT) = G(1/m)(dQ/dT)$$

This leads to

$$v = v_o e^{(G/m)Q}$$

Defining temperature by the solid itself through the equation—

$$v\,t = v_o e^{\alpha t}$$

we get

$$(G/m)\,Q = \alpha t - \beta$$

which determines the heat content itself in terms of the temperature. Also the specific heat is given by

$$s = (\alpha/G)$$

(62) *Wiedemann-Franz's Law as Composition of the separate Identity (or atomicity) of Molecular Conductivities, Thermal as well as Electrical :* (Proc. Indian Science Congress, 1932).

From an argument given in the paper on the colloidal theory of molecular weights, submitted to the Chemistry Section of the Congress in 1931, it was found the two conductivities would themselves be constant. It was tested by two teachers of the Isabella Thoburn College, Lucknow, Miss S. Ghosh and Miss J. H. Inglis, who found that they were atomic and not constant. The values of Wiedemann-Franz's ratio were then calculated from the latest values in the Physikalische Chemische Tabellen and found to be not constant but also atomic to exactly the same extent as the two component conductivities themselves. The atomicities cannot be explained away as errors by any means.

(63) *Atomicities in the Lowering of the Solidification Point of Solutions of Metals in Metals :* (Proc. Indian Science Congress, 1932).

From the same tables solutions in 9 metal solvents of 22 metal solutes were examined for a Raoult's Law analogue, an atomicity can be easily seen. The atom of the " Gefrierunganiederung" for the different solvents were to one another as 1 : 3 : 1 : 4 : 10 : 3 : 5 : 3 : 4.

(64) *On the Solution of the Diaphantine Equation* $n_1^2 + n_2^2 + n_3^2 = k$: (Proc. Indian Science Congress, 1932).

In connection with a physical problem, the solution of the above equation was wanted. In the absence of any method known to the author, 2 eight valued, 2 seven valued, 17 six valued, 29 five valued, 55 four valued, 93 three valued, 169 two valued, together with hundreds of one valued solutions were obtained, by trial. Thus 374 is the sum of the squares

of 6, 7, 17 ; 5, 8, 18 ; 2, 3, 19 ; 1, 7, 18 ; 2, 9, 17 ; 7, 10, 15 ; 3, 13, 14 ; and 6, 13, 13 ; whilst 446 is the sum of the squares of 6, 7, 19 ; 2, 9, 19 ; 1, 11, 18 ; 6, 11, 17 ; 10, 11, 15 ; 9, 13, 14 ; 5, 14, 15 ; and 1, 2, 21.

(65) *The Meaning of Pressure:* (Proc. Indian Science Congress, 1932).

Pressure is dimensionally force per unit area, energy per unit volume, and energy streaming into the surface per area per unit time with velocity v. In kinetic theory pressure is dimensionally $(N/V)mc^2$. This is very akin to the heat content per volume. The specific heat is dimensionally $(1/\rho)(d\rho/dT)$, so that either an infinite value *of* ρ, as for gases at $0^{\circ}A$, or zero value of the vapour pressure variation with temperature, as for solids, will make the specific heat equal to zero at absolute zero. For a constant value of specific heat for gases N/V must be constant, that is, the Avogadro's Number must be proportional to the volume, or what is the same thing, to the absolute temperature.

(66) *On Parallel Possible Solutions of the Virial of Internal Forces of a Gas and Cauchy's Stress Distribution Laws in a Solid:* (Bulletin of the U. P. Academy of Sciences, 38, p. 46, Vol. I, 31-2).

Algebraic and exponential types of solutions are given showing how passage takes place in the Continuity of State from the gaseous to the solid condition, *via* the liquid state, by a variation in the numerical value of the parameters.

(67) *On the Relation between the Energy Current Incident on an Auditorium Wall and Gauss's Theorem :* (Benares Mathematical Society, 1932).

By an application of the Gauss's Theorem to acoustics it is mathematically proved that an absorbent surface at the centre of the floor of a cubical auditorium is 5 times more efficient than when placed at a corner.

(68) *On the virtual Independence of the Reverberation Period from the Volume of the Auditorium:* (Bulletin of the U. P. Academy of Sciences, 29, p. 45, Vol. I, 31—2).

It is shown mathematically that the reverberation period does not increase with the volume of the hall as supposed, but is a constant as expected physiologically.

(69) *On the Dependance of the Reverberation Period on Pitch:* (Bulletin of the U. P. Academy of Sciences, 1932).

It is shown that the reverberation period decreases as pitch increases, thus explaining the physiological perception of better audition with higher pitches mentioned in the author's University Extension Lecture on the Physics and Physiology of Acoustics of Buildings.

(70) *On a Generalised Formulation of Trouton's Law:* (Indian Science Congress, 1933).

In a paper submitted to the U. P. Academy of Sciences, on the Parallel Possible Solutions of the Virial of Intermolecular Forces in Gases and Cauchy's Fundamental Stress Equations for Solids, it has been shown that a variation of force according to an exponential law is capable of giving a gradual transition from a huge intrinsic negative pressure inside a solid or liquid to a small positive vapour pressure at the surface.

This relation is applied to the special cause of a drop of a liquid evaporating from its surface. The laws assumed for the liquid are:—

$$X_l = -A_l \left\{ e^{+k_1(x+y+z)} + e^{-k_1(x+y+z)} \right\}$$

and for the gas.

$$X_g = +A_g \left\{ e^{+k_2(x+z+y)} + e^{-k_2(x+y+z)} \right\}$$

It is shown this leads to the result :—

$$k_2/k_1 = log\ (mL/RT)$$

At the critical temperature.

$$k_1 = k_2$$

and

$$X_l = O = X_g$$

This generalisation, therefore, removes the difficulty pointed by Saha and Srivastava in Trouton's Law (Text Book of Heat, p. 223) and makes the result valid up to the critical temperature.

(71) *On the production of (1) the Wolf Note, and of (2) Circular, and (3) Torsional Vibrations in a Melde's string.* (Indian Science Congress, 1933).

In *Nature* of February 1932, the production of a periodic vibration of Melde's string by a continuous force, transverse or longitudinal, has been reported by a present writer. (i) The Wolf Note, or periodic alternation between the fundamental and its octave, (ii) circularly polarised vibration, and (iii) torsional vibration have also been obtained with Melde's string with such excitation.

(72) *On the Variation of Potential with Depth of a Liquid:* (Indian Science Congress, 1933).

A copper calorimeter was placed on a non-conducting stand and a copper wire was soldered to the bottom and used as a terminal of a galvanic element. The other terminal was a copper wire soldered to the copper rod placed along the axis of the calorimeter, without touching the bottom. The fluid employed was distilled water. It was found, when the rod was gradually raised, the potential as measured by a Crompton Potentiometer was fairly constant in the bulk of the liquid, a variation appearing near the bottom as also near the surface It is believed adsorption and surface tension have to do with these variations. The voltage was of the order of 50 millivolts.

(73) *The Theoretical and Empirical Formulae in Emission Spectra:* (Proc. Indian Science Congress, 1928).

The Table for rotation spectra from Lewis's Quantum Theory is taken and two tables are given, one theoretical and the other empirical, showing better agreement with experiment than the tables of Bohr, Bjerrum and von Bahr.

(74) *On an evidence of the James Thomson state of matter:* (Proc. Indian Science Congress, 1929).

The way in which the graph of van der Waals' equation runs is well known. The portion between the maximum and minimum in the graph is not experimentally obtained although prolongations of the curve towards this maximum and minimum are said to be experimentally found.

Mattauch in Vienna claims to have found in Ehrenhaft's laboratory values of the electron identical with that given by Millikan. The mathematical analysis giving this agreement, however, has the drawback that the density of the particles is found not to be constant but to vary within a range of 1: 19 for the different particles of the same substance.

The present writer in Koll. Zeit, 44, 186, 1928, has shown that the particles are hollow bubbles with a gas core held within a film of selenium. When Mattauch's values of pressure and radius are plotted in a graph as y and x coordinates, the graph resembles that corresponding to van der Waal's equation. As volume is proportional to the cube of the radius, the nature of the graph would be unaltered except for a change of scale and a distortion. The author, therefore, believes that we have an experimental evidence of the James Thomson part of van der Waals' gas equation.

(75) *A note on Osmotic Pressure:* (Proc. Indian Science Congress, 1929).

What Lecher's Lichtzug is in Ehrenhaft's negative radiation pressure, that is Osmotic Pressure in the Kinetic Theory. The negative character of the osmotic pressure is, generally, not properly realised. As $p = (1/3)\ nmc^2$, there is no provision of such a negative pressure in kinetic theory. In this connection it is refreshing to note the intellectual honesty with which the enunciator of the Law of Distribution of Velocities amongst the Molecules confessed the possibility of explaining the whole behaviour of gases by the second term of the Virial of Clausius without any aid of the kinetic theory. In this admission of Maxwell lies the explanation of the osmotic pressure exerted by the particles of a dissolved substance.

(76) *On the Classical Genesis of Planck's Radiation formula:* (U. P. Academy of Sciences, 1932. Read at Post-Graduate Class on the Faraday Centenary Day).

It is suggested that Planck's formula was hitted upon from an empirical modification of Wien's formula such as would remove the difficulty of Rayleigh's modification. Thereafter the geometric series which was equivalent of the algebraic expression was sought to be physically explained. This explanation is pointed out to be against the principle of variability of light velocity with amplitude proved by the author in Zeit. f. Physik, 1921, and a structure of the source in consonance with his colloidal theory of matter is given which by the probability of the distribution of sizes from zero to infinite radius, indicated from other sources, would give an explanation of the geometrical series of Planck consistently with Classical Dynamics.

(77) *On Melde's String as the Limiting Case of the Violin String:* (U. P. Academy of Sciences, 1932. Communicated to Philosophical Magazine).

The inadequacy of the analysis of the violin string by Helmholtz and Raman are shown. Rayleigh's observations on

the indeterminate character of the Melde's string investigation is emphasised, and it is shown that without assuming with Ghosh and Raman a new law of resistance, the experimental results of Ghosh, (Sound, p. 129) can be explained.

(78) *On the Physical Meaning of Gas Degeneration process:* (Communicated to Prof. Dr. M. Bodenstein, March, 1932).

The discovery of Nernst known as "Gas Degeneration" is explained from the law of variation of the Avogadro's Number with the change of state,

(79) *The Expanding Solar System:* (Communicated to Sir Arthur Eddington for the Physical Society Proceedings).

It is shown that if with Sir J. J. Thomson's atomic dynamics, we introduce an inverse cube law superposed on the inverse square law in Celestial Mechanics, the solar system is found to be expanding at a rate calculable from data on record, as done by the author's colleague, Prof. N. N. Bose of Lucknow Christian College, for him.

(80) *A Possible Interrelationship between Tropopauses and Heaviside Layers*: (Proc. Indian Science Congress, 1932).

Meteorologists believe in only one Tropopause, it being assumed to be a minimum of temperature for the thermic radiation field of the sun and the earth.

The decrease in the velocity of the balloon ascent before, and the increase after, passing through the tropopause cannot, however be explained. In a paper on a Colloidal Theory of Gases accepted by Kolloid Zeitschrift (56 166, 1931), a bubble like structure of the gaseous ions has been proposed. These will burst at certain heights, depending upon the mass of gas enclosed and the film containing it. As the core and the film are of opposite charges they will move in the earth's field in two opposite directions. The balloon will, therefore,

experience two impulses in opposite directions in passing through the boundary surfaces of the tropopause regions.

This bursting of bubbles will also give rise to reflecting walls spherical and concentric with the earth's surface from which reflections of wireless waves will be obtained as in practice. These walls, or tropopause layers, theoretically, can be more than one in number, and their heights are supported, to a first approximation, by the E and F regions of Appleton's Electric Structure of the Atmosphere.

(81) *On a Photoelectric Theory of Photographic Plates:* (Proc. Indian Science Congress, 1927. Communicated by Prof. P. S. MacMahon to the Journal of Physical Chemistry).

It is submitted that the process of development is analogous to 'etching'. The intrinsic electric charge on silver salts in the plate absorbs a layer of opposite sign. This layer takes the place of the wax coating in etching. Light falling on it removes by photoelectric effect, (see model of the process as pictured by the author in Zeit. f. Phys. 33, 231, 1925), by different amounts and makes the salt accessible to the developing solution by different amounts. The process of fixing then removes the unacted upon salt when the etching process is stopped.

Photographs on plates and papers were obtained with tin plate and coins in contact and connected to terminals of Wimshurst machine. A reversed effect with the tin plate was obtained with reversing the sign of charge given, as indicated by theory. With the coins this did not take place. The cause may be heaving up of the salt molecules under the electric force which more than counterbalanced the greater density of absorbed layer.

At the suggestion of Professor MacMahon the electrical resistance was tested between the charged metal plate or coin

and the photographic plate. With the 220 volts mains and a sensitive mirror galvanometer not even a fraction of a microampere could be detected.

The apparatus and prints were exhibited in the Conversazione on 3rd March 1927, in connection with the laying of the foundation stone of the New Chemical Laboratory of the University.

LUCKNOW UNIVERSITY EXTENSION LECTURES.

(1) *Discovery of Rajendra Nath Bhar and its bearing on Relativity :* (1st November, 1928).

(2) *Interpretation of the Raman Effect :* (15th November, 1929).

In the course of a Lucknow University Extension Lecture on November 15, 1929, on the interpretation of the Raman Effect, a copy of which has reached us, Mr. Satyendra Ray put forward a novel point of view. He looks on the Raman lines as related to an effect which he calls the Bhar Effect namely, that the position of a line in a spectrogram depends upon the intensity of the source, which is taken to prove that the velocity of light is not constant, but depends upon the amplitude, analogously with sound. In the experiments on this effect made in 1925 by Mr. Ray using Rhodamine solution to weaken the D-lines by absorption and so vary the effective amplitude of the source, the D-lines shifted different amounts for different concentrations of the Rhodamine solution, and for the critical densities gave rise to a continuous band. This is taken to be connected with the Raman Effect, and particular attention is directed to the continuous spectrum often found in Raman spectra. Mr. Ray believes that a classical dynamical interpretation of Raman Effect can be made if it is recognised that the velocity of light is variable, that transformation of frequency are possible, and that combinational tones are pos-

sible, whether differential or summational." [Review by " Nature ", p. 647, April 26, 1930].

(3) *Physics and Physiology of the Acoustics of Buildings, particularly of the U. P. Council Chamber, Lucknow :* (13th December, 1930. Printed as Ward Memorial Publication).

(4) *Faraday Ratio in a Colloidal Theory of Matter :* [Michael Faraday Centenary Day, 21st September, 1931].

(5) *On the Tyranny of Mathematics:* (3rd December, 1932).

The tragedy of Physics without mathematics and mathematics without Physics is brought out, and a plea for revision of mathematical methods is made.

Satyendra Nath Ray and Nalini Nath Bose, (Department of Mathematics, Lucknow Christian College.)

The Perihelion Motion of Mercury : (Proc. Indian Science Congress, 1930).

By the addition of a cube law to the inverse square law in the expression for the force between the nucleus and the planet, in a manner analogous to atomic dynamics of J. J. Thomson, it is shown that within the limit of accuracy of astronomical determinations of the perihelion motion as recorded, this motion can be explained.

Satyendra Nath Ray and H. P. Chowdhury.

Theory of Liesegang Phenomena by Evaporation from Walls : (Proc. Indian Science Congress, 1933).

Liesegang deposits have been observed by the authors by dipping strips or blocks of tied blotting papers in red ink or inorganic salt solutions. These phenomena under the conditions can be explained by applying an analogue of the well-known formula of heat conduction :—

$$dq = K\,A\,(dc/dx)\,dt$$

where c is the concentration of the solute going across a cross-section. A periodic variation of c, the concentration, with height can be obtained by assuming the loss of water from the faces exposed to the atmosphere to be proportional to the vapour pressure and therefore to the factor $(1-kc)$.

Closer or more distant rings or layers, found in Liesegang phenomena, can be explained on the basis of the results thus obtained. The effect of wetting the block, as well as of the humidity of the atmosphere, as indicated by the theory, has also been qualitatively verified.

PAPERS BY PUPILS, OMITTED IN THE "ABSTRACT OF PUBLICATIONS BY THE MEMBERS OF THE UNIVERSITY, 1921-1927".

A Critical Examination of Millikan's Data on the Charge of the Electron: being papers written by **C. L. Srivastava, S. P. Chakravarti, D. V. Gogate, B. P. Saksena, and S. N. Moitra.** Incorporated in a work entitled "Reconciliation of Millikan and Ehrenhaft: A Colloidal Theory of Matter," sent to Professor Dr. Hans Pfeiffer of Bremen, for publication in Germany.

PAPERS BY STUDENTS, COMMUNICATED BY **Satyendra Nath Ray.**

B. N. Srivastava.

Ueber die Veraenderlichkeit der Oberflaechenspannung des Wassers bei zunehmender Dicke der Glasplatten: (Kolloid Zeitschrift, 55, pp. 45-49, July, 1931).

This paper describes experiments with the Searle's tensiometer and, from the data obtained, it is shown that the total force exerted by the liquid surface on a glass plate may be expressed as the sum of two forces which are proportional respectively to its area and perimeter. The theoretical discussion is given separately by S. Ray (*Ibid.*, pp. 49-51, July, 1931) based on the colloidal theory of surface tension. [Abstracted by H. H. Ho in S. A., 1931.]

N. N. Bose.

(1) *Fourier's Analysis subject to certain Quantum Conditions.* (Bulletin Acad. Polonaise Sci. et Lettres, 4·5, A. 225 - 227, April-May, 1929).

A brief note on a modified Fourier analysis applicable when the ratio of amplitude to wave-length is constant for the harmonics. [Abstracted by W. H. George in S. A. 1930.]

(2) *Lommel's Analysis and Continuous Spectra:* (Proc. Indian Science Congress, 1928).

Spectra are of three kinds in general, the primary line spectra, the secondary line spectra and the continuous spectra. The first is supposed to be explained by Bohr's hypothesis. The second is a little more difficult to explain and experimental data are far from complete: *e.g.*, for the simple element *H* alone Deodhar has recently found as many as 450 new lines. If Ray's hypothesis of explaining them from Fourier's analysis be accepted, the constancy of "second differences" found in Deodhar's experiments indicates the existence of more than twice the lines still remaining undetected. The continuous spectrum is still unexplained. This can be explained by resorting to Lommel's analysis, which is capable of giving a continuous train of waves corresponding to a monochromatic radiation. The "flat tuning" met with in wireless telegraphy is also thus explained."

(3) *On the Resonance excited by an Impressed Vibration with Decaying Amplitude:* (Proc. Indian Science Congress, 1928).

It is shown that the resonance excited by such an impressed force in a particle subject to damping resistance is of the nature of a continuous spectrum of all possible wave-lengths with their amplitudes varying in the particular manner given by Lommel's analysis.

M. H. Ahmadi and H. L. Tandan.

Ueber Die Verletzung des Ohmschen Gesetzes durch Wechselstroeme in Stromkreisen die Kapazitaet und Widerstand enthalten: (Zeitschrift fuer Electrochemie, 35, 471-473, 1929).

Theoretical. *Cf.* Ray this vol. 228, (passage of electric current etc). [Abstracted by H. T. S. Britton in B. C. A. 1930.]

Binda Prasad Srivastava and Krishna Gopal. *On the Nature of Discharge through a Neon Tube:* (Proc. Indian Science Congress, A-49, 1927).

During Ray's experiments on the change in wave-length by passage of light through an absorption filter, and on the conversion of line spectra into continuous ones under specific values of concentration, the authors examined the Neon Tube discharge by means of a rotating mirror. With the Neon Tube capillary and the axis of the rotating mirror vertical the discharged got drawn out into a flag shaped band. The band was composed of a number of parallel sine curves inclined to the horizontal over which was superposed a number of parallel dark bands. With the change in the direction of the discharge the inclination of the sine curves to the horizontal was reversed. The effect is sought to be explained by the hypothesis of mass motion of charged atoms under the powerful intermittent electric force The Doppler effect was experimentally verified with the spectrometer.

S. K. Dutt and S. S. Sharma.

On the variation of wave-length parallel to the length and along a diameter of the cross-section of a Cooper-Hewitt Mercury Lamp: (Proc. Indian Science Congress, 1928).

Light was made incident by reflection on a spectrometer slit by a mirror capable of rotating about two axes at right-

angles to each other. The spectrum was examined by a reflection grating. A distinct variation in the value of wavelength was noticed both when the mirror was rotated so as to send the light from different points along its length, as also when rotated so as to send the light from different points of a transverse cross-section.

N. N. Ienger.

On the Theory of Consonance of Helmholtz: (Proc. Indian Science Congress, 1928).

Attention is drawn to the arbitrary assumption of Helmholtz of the dissonance being maximum with 33 beats per seconds. Also to the absence of the mathematical discussion of beats except when the notes are nearly in unison or very nearly a harmonic of another. Helmholtz in Appendix XIV has shown clearly, that the resultant note varies firstly in amplitude, and secondly in pitch with time, the range of pitch variation depending upon the amplitudes of the two notes. In other words, the compound note is not periodic in any sense of the term. A pseudo-interval may be sought from any of the three relations, $y=o$, $dy/dt=o$, and $d^2/dt^2=o$. They will give different pitches very close to each other varying through different ranges, producing beats which Helmholtz did not reckon. Taking them into consideration we may get better agreement between subjective ohservations and theoretical results from Helmholtz's theory than we do at present.

H. L. Tandon, Ram Saran and B. B. L. Saksena.

A note on the determination of Stefan's constant with Denning's apparatus: (Proc. Indian Science Congress, 1928).

The experiment as described in Flint and Worshop's Practical Physics was found to give inconsistent values of the constant. A correction for the radiation from the underside of the silver disc, empirically applied, made the value of the

constant as determined for different temperatures identical in value. This value was, however, still, very much smaller than the proper value of the constant, being only a quarter of it in magnitude. The mass of the silver disc with lamp black and solder, connected to the wires of a thermo couple element form a system of which the thermal capacity is rather difficult to specify with accuracy. Attempt at elimination of this error, like elimination of the error due to radiation from the under surface mentioned above, lead to no success.

D. V. Gogate.

(1) *On the Damping Factor of a Ballistic Galvanometer :* (Proc. Indian Science Congress, 1929).

Ray found that correct values of capacity and inductance were not found unless the damping factor for the *actual circuit* was determined experimentally or by extrapolation, and that the formula $\lambda = a(1/R+p)$ was not correct. This has been carefully tested and the experimentally obtained mode of departure from the theoretical formula is given in graphs showing the mode of variation of a and p with R.

(2) *On Anomalous Values of Galvanometer Resistance :* (Proc. Indian Science Congress, 1929).

Experiments for the determination of Galvanometer resistance by the method of substitution gave values which were found atomic. These values were confirmed by means of a Wheatstone's Bridge with an alternating *e. m. f.* Ray had noticed previously atomic values of L and C with a Drysdale Bridge, which he attributes to different harmonics of the *e. m.f.*, obtaining in the different arms of the bridge. The multiple values of resistance, found with steady currents, however, do not admit of the explanation given for atomic values of capacities and inductances. (For explanation see Ray Zeit f. Etektrochem, p. 756, 1928).

T. P. Gaurgas.

(1) *Relativity in Thermometry:* (Proc. Indian Science Congress, 1929).

In dilatational thermometry in the (v, t,) graph we really plot the volume of one substance against another, the second being called the "thermometric substance". If the role of the two substances be interchanged, a simple geometrical relationship will subsist in the two (v, t) graphs obtained. By suitably defining the "points of temperature", it is possible to obtain the same graph for the two cases, *viz.*, a straight line through the origin. It is obvious this temperature scale would be less liable to arbitrariness than the ones obtained by assuming any single of the given substances alone to expand "regularly."

(2) *The Einstein-Jaeger Derivation of Brownian Movement:* (Proc. Indian Science Congress, 1930).

It is shown that the probability expression used must involve time, just as well as the distance travelled. If we make this correction we do not get the *Verschiebungsquadrat* increasing with time, as it does in the accepted formula. This is in consonance with Svedberg photographs.

(3) *A Generalisation of the Equation of Motion for Dispersive Media:* (Proc. Indian Science Congress, 1930).

A kinematical generalisation is given, capable of expressing waves we meet with in investigation of group wave velocity. de Broglie's relation $uv = c^2$ is satisfied as a special case when the parameter l is equal to 2.

Babu Ram Kapila.

On the Compressibility of Water Vapour before and after Condensation: (Proc. Indian Science Congresss, 1929).

At the suggestion of Satyendra Nath Ray, it was attempted to compare these compressibilities by assuming that the vapour

was condensed in the form of N drops of equal diameter, the drops being merely the vapur, being only enclosed in a film of surface tension T. It was found from this point of view that the vapour inside this bubble is *more* compressible than the vapour outside, and that the value of N increases with temperature.

P. N. Sharma and S. H. Naqvi.

Capacity in Drysdal Bridge. (LABORATORY NOTE—in Journal of Scientific Instruments, December, 1928).

B. B. Kak and S. K. Ghose.

On the Equation of State of Saturated Vapour: (Bulletin of the U. P. Academy of Sciences, 1932).

A Mathematical limitation of D P. Misra's investigation (Tohuku Math. Journal, 1931) is shown.

Ray's theoretical formula for the equation of state for gases.

$$pv/DT = A_e^{-n/pvT}$$

is verified for the saturated vapour of water from Zeuner's observations in Landolt and Bornstein's Tables.

Gopal Das Kshetrapal.

A formula for the locus of discontinuities in the Isothermals of Brombenzol: (Bulletin of the U. P. Academy of Sciences, 1932).

The graph of pv/DT plotted against $1/pvT$ gives one straight line for the saturated vapour condition and another for the condensed liquid phase, the lines intersecting on the y axis.

A. K. Cherian and A. I. Abraham.

An experimental determination of the Law of Variation of the Avogadro's Number with Hofmann's Vapour Density Apparatus: (Bulletin of the U.P. Academy of Sciences, 1932).

The formula $N = Ne_o^{-a'pvT}$ is verified to a first approximation.

D. P. Misra.

Van Der Waals' equation and the boundary between the Homogeneous and Heterogeneous Regions : (Tohuku Math. Journal, 34, pp. 328-348, August, 1931).

A simple analysis of van der Waal's equation shows that it has no physical significance at temperatures below $(27/32)\ T$ where T is the critical temperature. The equation of the boundary in the $p - v$ diagram of the region in which the substance co-exists in the gaseous and liquid states is then found. For this purpose, use is made of the principle that if A and B are the terminal points of the constant pressure portion of an isothermal found by experiment, then between these two points the isothermal deduced from van der Waal's equation is a curve. The work done, however, in expanding from A to B is the same, by whichever route the expansion progresses. By introducing a parameter to be determined separately from available data, the required equation for the locus of A and B is obtained for the first time. Consideration shows, however, that it includes portions other than the locus. These parts have been introduced by the mathematical method which does not distinguish between physically significant points and others. [Abstracted by J. P. A. in S. A., 1931.]

D. V. Gogate and Y. G. Naik.

The Polarisation of Cells : (Proc. Indian Science Congress, 1930).

Ahmadi and Tandan have proved the futility of employing *a. c.'s* in the determination of electrolytic resistances. This makes the study of " polarisation " of paramount importance. Electric cells themselves furnish the best subject of study in this matter. The decay of *e. m. f.* with time to a limiting value, and the increase of internal resistance to a corresponding value seems to be indicated. Log $(E_o - E)/E_c$ plotted against t does not give us a rectilinear graph.

Ram Saran and Jagdish Narain Saksena.

The Polarisation of Electrolytes. (Proc. Indian Science Congress, 1930).

With feeble currents the polarisation of electrolytes was studied by taking the variation of resistance with time. It was found that the resistance rose to a steady limiting value from 12 minutes to an hour.

A. C. Banerji and H. S. Jain.

An electrical Liesegang Phenomenon: (Proc. Indian Science Congress, 1930).

A wire-like formation formed by the passage of an arc between two hard steel electrodes showed on examination a striated structure. It is believed it is a Liesegang Phenomenon of the type indicated by Ray in Koll. Zeit., 54, 277, 1928.

K. N. Mathur, A. H. Compton, and H. R. Sarna.

(1) *An attempt to Detect a Unidirectional Effect of X-Ray Photons :* (Physical Review of America, Vol. 31, 1928, and Indian Journal of Physics, Calcutta, Vol. 3, 1929).

It seemed possible that X-ray pulses excited by the impact of cathode particles on a target might emit more photons with their electric axes antiparallel to the cathode stream than parallel to it, corresponding to Stoke's unidirectional pulse.

More photo-electrons might thus be ejected parallel to the cathode rays than antiparallel. This was tested by passing a narrow sheet of X-rays from the tungsten target of a Coolidge X-ray tube, midway between two wire gauzes separating an ionisation chamber into two portions.

K. N. Mathur, and H. R. Sarna.

(2) *The absorption of X-Rays by Colloidal solutions*. (Proc. Indian Science Congress, Calcutta, 1928).

A narrow beam of X-rays from a Coolidge tube was filtered and passed through different Colloidal solutions contained in small glass cells with thin windows. Absorption coefficients measured give abnormally large values showing the large refraction of the X-ray beam by the metal particles.

K. N. Mathur, S. S. Bhatnagar, and P. L. Kapur.

(3) *Magnetic Properties of some substances in the adsorbed state* : (Indian Journal of Physics, Calcutta, Vol. III, 1928).

A magnetic study has been made of a number of substances by adsorbing them on Charcoal and Silica. It was conclusively shown that in the case of charcoals, iron, nickel, cobalt, and manganese entirely lose their strongly paramagnetic properties and become diamagnetic.

K. N. Mathur, S. S. Bhatnagar, D. L. Srivastava, and R. K. Sharma.

(4) *Tesla Luminescence Spectra of the Halogens-Part I, Iodine :* (Philosophical Magazine, London, Vol. V., 1928).

Iodine has been examined spectroscopically by excitation under electrodeless Tesla discharge. Four systems of bands were noted and one of them analysed. A brief discussion was also given of the two bands called " Electron affinity " bands.

K. N. Mathur, S. S. Bhatnagar, and R. N. Kapur.

(5) *The Effects of Magnetic Field on certain Chemical Reactions :* (Philosophical Magazine, London, Vol. VIII, 1929).

A large number of Chemical reactions have been examined within and without strong Magnetic Fields. Reactions were thus divided into three classes : (*a*) Those in which the field accelerates the velocity of Chemical reaction. (*b*) Those in which the velocity is retarded in the presence of the field. (*c*) Those in which it remains unaffected. As a general rule it was found that those reactions in which the sum of the molecular susceptibilities increased during the course of the reaction were accelerated by the impressed Magnetic Field and those in which the sum decreased during the reaction were retarded by the Field.

K. N. Mathur, S. S. Bhatnagar, R. S. Gupta, and K. G. Mathur.

(6) *Die Wirkung von Rœntgenstrahlen auf Kolloidale Lœsungen :* (Zeits. fuer Physik, Berlin, Band 56, 1929).

Metallic colloidal solutions of different substances like Ag, Cu, Au, Fe, were exposed to X-rays for long periods varying from 2 to 6 hours and the changes produced in migration velocities were noted. Tests were also made on protected and unprotected colloids.

K. N. Mathur and S. S. Bhatnagar.

(7) *A new Magnetic Balance and the Magnetic Susceptibilities of some allied Diamagnetic Compounds* : (Proc. Indian Science Congress, Allahabad, 1930).

A new Magnetic balance involving several new principles has been designed. The suspended system has been made very light and small. The beam has been shortened to about

one-tenth the size of the Curie and Wilson types. The electromagnet employed carried especially designed pole-pieces with a third pole fixed in the middle. This arrangement gives two non-homogeneous fields, of which the gradients are arranged in opposite senses. Observations are taken by a ballistic method and " throws " are measured. The method very successfully overcomes the difficulties of torsion head measurements.

K. N. Mathur, S. S. Bhatnagar, and B. D. Jain.

(8) *The Magnetic Rotatory Behaviour of some optically Active Substances in Solution* : (Indian Journal of Physics, Calcutta, Vol. VI, Part IV, 1930).

Several optically active substances in solution were examined for their magneto-rotatory behaviour. They were placed inside a current carrying solenoid and the strength of the current was increased until the magneto-rotation just neutralised the optical rotation of the solution. The following facts were brought out (1) that for any particular solvent the current and hence the field required to just balance the optical rotation is proportional to the optical rotation itself, (2) that unlike optical rotations the Magnetic rotation of optically active solutions of a substance is independent of the concentration within a wide range.

K. N. Mathur and T. K. Lahiri.

(9) *The use of photographic self-timers as Precision Timing Instruments* : (Journal of Scientific Instruments, London, Vol. VII, 1930).

The performance of photographic self-timers has been investigated by means of a vibration galvanometer. It has been found that the self-timers are quite reliable instruments in so far that exposures can be repeated with good accuracy, but no reliance whatsoever can be put on the readings indicated on the dial, which may be very much in error.

DEPARTMENT OF CHEMISTRY.

The following papers were published in the period under review. Some were originally read at the Indian Science Congress and noted down as such in the first Quinquennial Report. Work was further extended and then published in the various Journals as detailed below :—

P. S. MacMahon and A. C. Chatterji.

Action of light on silver bromide : (Journal of the Indian Chemical Society, 1930. British Chemical Abstracts, 1930, p. 1136).

The photochemical darkening of silver bromide when exposed to oxygen for prolonged periods is accompanied by absorption of oxygen (69·2g. exposed for one year to tropical sunlight absorbed about 2 cc. of oxygen). Disperse silver prepared by striking an arc between silver electrodes is also capable of oxidation when exposed to dry oxygen. It is therefore suggested that the photo-halides formed are not due to the photochemical synthesis of an oxycompound but are due partly at least to the direct absorption of oxygen by the disperse silver produced in the photochemical decomposition of the silver halide.

P. S. MacMahon and M. Raman Nayar.

(1) *Electrolytic preparation of silver oxide :* (Journal of the Indian Chemical Society, 1930. British Chemical Abstracts, 1930, p. 1382).

Pure silver electrodes are dipped in conductivity water in a silica beaker and an arc is struck for 1-2 minutes, when enough silver oxide is produced to make the water a fairly good conductor. The electrodes are then separated 2-3 mm and ordinary electrolysis is continued. A dark brown coating of silver oxide forms on the anode and may readily be scraped

therefrom by means of a silica rod. No silver peroxide appears in the product, which however contains about 30 per cent metallic silver.

(2) *Kohlschuetter's method of preparing silver hydrosol*: (Journal of the Indian Chemical Society, 1930. British Chemical Abstracts, 1930, p. 1517).

Pauli's views on the preparation of silver sols by Kohlschuetter's method (Reduction of silver hydroxide by means of hydrogen) are criticised and certain of his experimental observations are contradicted; the presence of free alkali is not essential for sol formation, and metallic silver has a marked anticatalytic influence. Reduction of silver oxide in a silvered glass vessel results in the formation of a thin white unstable sol, but in silica or glass vessels a stable red sol is always obtained. The mechanism of the process is probably

(1) $A_{g_2}O \rightleftharpoons A_g^{+} + (A_gO)^{-}$ (2) $AgOH \rightleftharpoons A_g^{+} + (OH)^{-}$

the $(A_gO)^-$ ion becoming the nucleus of the colloidal particle. The influence of metallic silver is due to an increase of the Ag.-ion concentration in the neighbourhood of the walls of the vessel and consequent reversal of the first equation and removal of the $Ago.^1$ nuclei. A stable sol may be prepared by reduction at 85°, but at the boiling point a coarse suspension is formed. The dialysed sol did not coagulate after 18 months.

P. S. MacMahon, J. M. Dhar, and H. G. Dayal.

The photo-chemical reduction of aqueous solutions of silver salts of organic acids: (Proc. Indian Science Congress, 1932).

The aqueous solutions of certain silver salts of organic acids were exposed to strong sunlight and the silver reduction product examined. The salts were found to vary greatly in their behaviour.

Some salts give complex silver sols, while others are reduced directly to $Ag-Ag_2O$ and no sol is formed. Some of the salts on reduction undergo different colour changes showing progressive alteration in the complexity of the sols. Of the salts so far investigated the sols derived from the citrate and oxalate, in common with the sol produced from silver oxide itself on photochemical reduction, are negatively charged. On the other hand the tartrate and malate do not appear to give negative sols of the ordinary type, or to be able to retain their charges for any length of time.

The acetate, malonate, succinate give no sols.

These remarkable diversions are still under examination and the nature of the different sols under investigation.

P. S. MacMahon, B. M. Gupta, and P. C. Mukherjee.

An investigation into the composition of milk at Lucknow : (Public Health Department, Government Press, Allahabad, 1932).

The paper represents the results of analysis of milk performed during a period extending uninterruptedly over 18 months. The following are the most important conclusions arrived at :—

(i) In mixed herd cow's milk the morning milk varies in richness from 4 to 5 per cent fat, and the evening milk from 5 to 6 per cent fat giving an average of 5 per cent in all. The milk of the United Provinces does not vary very much from the Bombay milk examined by Meggitt and Mann. There is a distinct tendency for the fat content to rise to a maximum about February, declining to a minimum about July after the beginning of the rains. This also applies to the solids-not-fat.

(ii) There does not appear to be any quantitative relationship between the richness of milk and the yield or length of

the period of lactation except in individual cases where any one of these factors may depart conspicuously from the normal. The figures given show a marked irregularity in the composition from day to day. There is a tendency for the milk to become richer in the latter stages of the period of lactation and the yield smaller. The chief characteristic of Indian milk is the extraordinary variation shown by different animals as regards yield and richness of milk and length of lactation period.

(iii) The milk of Indian cows is richer than those of Europe but the yield smaller.

(iv) In mixed herd buffaloes' milk the morning milk varies in richness from 6·3 per cent to 7·4 per cent fat and the evening milk from 7 per cent to 8 per cent The composition appears to be less affected by seasonal changes than cows' milk. The solids-not-fat are also richer.

(v) The generalisations in paragraph (ii) also apply to buffaloes' milk.

(vi) The average yield of the buffalo is considerably greater than that of the cow, which places it as a milch animal of the highest economic importance.

(vi) Examination of the formula used by dairy chemists abroad in calculating the solid constituents of milk has shown a definite discrepancy both for cows' and buffaloes' milk. The numerical ratio usually assumed to exist between the sugar, proteids and ash for European animals does not hold good.

(viii) The enormous ranges of fluctuation in the fat and solid constituents of the milk samples investigated draw attention to the great care which must be exercised in pronouncing judgment upon the genuineness or otherwise of United Provinces milk, and the necessity of performing a complete analysis of the separate solid constituents in case of doubt.

The actual standards laid down fall below the richness reasonably to be expected from normal milk and would invite adulteration down to the minimum percentage of food constituents required by legislation, if such analytical precautions were not taken.

S. M. Sane and S. S. Joshi.

On the constitution of some dinitro-m-cresols: (The results on the constitutions of these substances have been published in the Journal of the Indian Chemical Society, Vol.V, 1928, pp. 299-301. British Chemical Abstracts, 1928, p. 1130).

S. M. Sane, S. N. Chakravarty, and B. N. Pramanik.

Behaviour of Nitrophenols with p-Toluenesulphonylchloride, Part II: (Journal of the Indian Chemical Society, Vol. IX, 1932, pp. 55-58).

In this paper the behaviour of (1) dinitrothymol, (2) dinitrocarvacrol, and (3) dinitro-p-cresotinic acid has been examined.

In the case of the first two the esters alone are formed and chloro-derivative cannot be obtained, although two nitro groups are present in ortho and para positions to – OH. The inhibiting influence of the methyl group is apparent here as it is in the case of dinitro-meta-cresol.

The dinitrocresotinic acid also forms an ester only, but this ester is not so stable as in the case of (1) and (2). It is decomposed by aniline but not by ammonia. Its diphenylamine and other allied derivatives have been described. (British Chemical Abstracts, 1932, p. 734).

S. M. Sane and Shiam Sunder Joshi.

Behavouir of Nitrophenols with p. Toluenesulphonyl-chloride. Part III: (Journal of the Indian Chemical Society, Vol. IX, 1932, pp. 59-65).

This paper contains the results of an extended investigation of the behaviour of a large number of dinitrophenols containing a chlorine, bromine or iodine atom in various positions as well as of a certain number of nitrooxybenzoic acids.

The paper describes the preparation of a large number of hitherto unknown chloro-bromo and chloro-iodo derivatives of benzene. The method investigated provides an excellent method of preparing such substances each of which contains a reactive chlorine atom. A large number of derivatives of the phenols used have been described. (British Chemical Abstracts, 1932, p. 734).

M. Raman Nayar.

Studies on supersaturation and crystallisation: (Proc. U. P. Academy of Sciences, 1931).

A dilatometric method of investigating a cooling solution has been developed. If plots are made of temperature and corresponding volume of the solution the curve gives very instructive inflexions at the point of saturation and at the release of supersaturation. The results obtained are comparable with those of Miers on refractive index measurements of a cooling solution.

A systematic study is being made to determine the supersolubility of substances and thus to find out the conditions under which a substance can be kept in a supersaturated state.

M. Raman Nayar and L. N. Srivastava.

Supersolubility of oxalic acid : (Indian Science Congress, 1933, Patna). At 80°a concentrated solution of oxalic acid decomposes. Supersaturation temperatures of solutions saturated at 70°, 60°, 50°, 40 ° were determined by means of the dilatometer. Each solution could be supercooled by about 6 degrees. The ratio of saturation temperature to supersaturation temperature was found to be constant.

M. Raman Nayar and Tota Ram Gairola.

Constitution of Iodic acid and Iodates: (Proc. Indian Science Congress, Patna, 1933).

Freezing point determinations of iodic acid solutions indicate that the acid is polymerised, the extent of polymerisation depending on the concentration. At ordinary dilutions (N/10) the acid has the simple formula and behaves like a monobasic acid. The salts have the properties of corresponding to the simple formula. Electrometic and conductivity titrations, Ostwald's conductivity law for the basicity of acids, conductivity curves of sodium and potassium iodates compared with other salts of mono and polybasic acids all indicate that iodate ion is a monovalent and not a divalent ion as has been recently stated.

A. C. Chatterji.

Liesegang phenomenon: Dr. Chatterji has published a number of papers bearing on this problem, which was the subject of his thesis for the doctorate.

(1) *Condition of silver chloride and other sparingly soluble substances in gelatine:* (Journal of the Indian Chemical Society, 1928, p. 5. 175).

Measurements of electrical conductivity of silver chloride and chromate of different concentrations in gelatine prove

that the observed conductivity is much less than the conductivity calculated on the assumption that these sparingly soluble salts exist wholly as ions in gelatine.

In the case of silver chloride the hydrogen ions in gelatine cannot dissolve silver chloride and hence the amount of free silver ions present is much less than in the case of silver chromate in gelatine.

The experimental results show that silver chloride and silver chromate formed in gelatine exist mainly in the colloidal state.

(2) *Theories of Liesegang rings and periodic precipitation:* (Journal Soc. Chem. Industry, 1929, p. 878).

Bradford's ion adsorption theory has been carefully scrutinised and its inadequacies pointed out. On experimental evidences it is difficult to support the contention of Bradford that clear spaces in Liesegang phenomena are due to the adsorption of ions.

(3) *Condition of silver chromate in gelatine from E. M. F. measurements:* (Proc. Indian Science Congress, Bangalore, 1932).

In a number of recent papers the suggestion has been made that $Ag_2 Cro_4$ remains in the supersaturated condition when precipitated in presence of gelatine. Electric conductivity of $Ag_2 Cro_4$ sol produced by the simultaneous addition of $Agno_3$ and $K_2 Cro_4$ to a gelatine gel was measured and the results reveal the fact that a large portion of the $Ag_2 Cro_4$ remains in a condition other than ionic.

A. C. Chatterji and S. C. Varma.

(4) *Adsorption of colloidal solutions and of ions by freshly prepared precipitate:* (Proc. Indian Science Congress, Madras, 1929).

In order to explain the free space between two consecutive Liesegang rings, a hypothesis was advanced in a number of previous papers that these spaces are due to the adsorption of the peptised sol rather than that of the reacting electrolytes.

In this paper experimental evidence is sought in support of the above view.

Freshly prepared precipitates of silver chromate, ferric hydroxide, etc., were used to adsorb electrolytes like silver nitrate, ferric chloride as well as sols of silver chromate and ferric oxide. It was found that the colloidal sols were greatly adsorbed whereas the adsorption of electrolytes was very little.

(5) *Adsorption of ions and sols by freshly prepared precipitates and its influence on the formation of Liesegang rings:* (Zeit. anorgu. allg. Chemie 1931, 196, p. 247, British Chemical Abstracts, 1931, p. 559).

During the formation of lead chromate by the interaction of lead acetate and potassium chromate no chromate ions are adsorbed by the precipitate, but a part of the lead chromate goes into the aqueous phase as a result of the peptising action of the chromate ions. Freshly precipitated and washed lead chromate does not adsorb more than 5 per cent of chromate ions and the amount adsorbed decreases with increase in the concentration of potassium chromate. The freshly prepared precipitate adsorbs a considerably greater amount of lead chromate sol. The adsorption of a sol of lead chromate stabilised by gelatine decreases as the concentration of gelatine increases, and at sufficiently high concentration of gelatine the adsorption is reduced to zero. This fact is believed to explain the difficulty of obtaining periodic structures of lead chromate in concentrated gelatine gels. The cause of the

spaces between bands of precipitate is traced to adsorption of the peptised sol by each band of precipitate and not to adsorption of the reacting electrolyte as assumed by Bradford.

A. C. Chatterji and L. N. Mukerji.

(6) *Studies on the formation of periodic precipitates. VI :*

Liesegang rings with the following precipitates could be obtained in silicic acid gel :—

Strontium sulphate ; ferrocyanides of silver, cobalt, nickel, manganese, copper, barium ; ferricyanides of silver, cobalt, nickel, manganese, copper, barium and zinc ; cyanides of silver, cobalt, nickel, copper and zinc ; phosphates of silver, aluminium, chromium and zinc ; silicate of silver, copper and zinc.

(7) *Studies on the formation of Liesegang rings and the peptising influence of gels. II :* (Kolloid Zeitschrift, 1930).

The coagulating influence of a number of electrolytes on $Ag_2 Cro_4$ sol prepared in a gelatine gel has been studied with a view to observe if Liesegang rings can be formed by diffusing the electrolytes from the top of the gel.

The nitrates of lead, zirkonium, barium and thorium produced clear rings when diffused from the top in a gelatine gel containing $Ag_2 Cro_4$ sol uniformly distributed.

The processes of peptisation and coagulation play an important part in the formation of Liesegang rings.

A. C. Chatterji, L. N. Mukerji, and J. M. Dhar.

(8) *Condition of sparingly soluble substances when formed in presence of gelatine and agar-agar :* (Proc. Indian Science Congress, Madras, 1929).

Electrical conductivity measurements and E. M. F. determinations have been done with a number of sparingly soluble salts such as PbI_2, Ag_2, Cro_4, etc., and it has been shown that the sparingly soluble salts remain in the colloidal condition.

A. C. Chatterji and J. M. Dhar.

(9) *Condition of sparingly soluble substances in presence of a gel. III.—AgBr AgI and AgCN in gelatine :* (Journal of the Indian Chemical Society, 1929).

Measurements of electric conductivities of silver chloride, bromide and iodide of different concentrations in gelatine prove that the observed conductivity is much less than the conductivity calculated on the assumption that the above silver salts exist as ions in the gel.

From the results obtained by E. M. F. determinations, it has been found out that in the Case Agcl, AgBr, AgI and AgCN, the amount of silver present in the ionic condition never exceeded more than 3 per cent, even when the concentrations of the sparingly soluble silver salts were considerably varied.

A. C. Chatterji and Pandey.

(10) *Condition of sparingly soluble substances in presence of a gel IV.—Lead iodide in agar and gelatine :* (Proc. Indian Science Congress, Allahabad, 1930).

In this paper the electric conductivity PbI_2 in agar-agar and ash free gelatine has been measured. Agar-agar was tested to be free from sulphate ions.

The conductivity of lead iodide in agar-agar is less than the conductivity of PbI_2 of an equal concentration when freshly precipitated in conductivity water, proving thereby that PbI_2 is more soluble in water than in an agar-agar sol.

Bolam and Mackenzie's (Trans. Faraday Soc. 1928. 24. 461) results have been scrutinised and it has been shown that from their own experimental results it is difficult to accept their conclusions.

Soorya N. Shukla.

A study on the preparation and properties of mercuric acetate: (Proc. Indian Science Congress, 1929).

With a view to study the causes of the low conductivity of acetates and mercuric salts, the preparation of pure mercuric acetate was undertaken.

Freshly precipitated mercuric oxide was dissolved in pure glacial acetic acid. In one case, an excess of the acid was added to the wet oxide the whole being warmed on a water bath till complete dissolution had taken place. In the other, dry mercuric oxide was added in small quantities at a time to boiling acetic acid till there was an excess of the oxide (Beilsteins, Band II, 113, 1920).

In both cases the products obtained gave reactions for mercurous ions, though the oxide was tested to be free from any mercurous ions.

At present the most suitable medium from which it can be crystallised out, is acetic acid, but it is very difficult to remove the last traces of the acid from the product obtained.

The solid is decomposed if exposed to air or in contact with water, alcohol, ether, chloroform, or benzene. An aqueous solution of the salt also decomposes, the decomposition is the greater the more concentrated the solution or the higher the temperature.

On the assumption that the substance was all mercuric acetate the conductivity values obtained were in fair agreement with those given by Ley in Zeit. Phys. Chem. (30), 248. 1899, but not with those given by the same author in Ber., (32), 1361, 1899 and in Abegg's Handbuch der Anorg. Chem., Band II, Abt. 2, 628, 1905.

THE FOLLOWING IS A LIST OF PAPERS PUBLISHED BY **S. N. Shukla**, WHILE HE WAS A STATE SCHOLAR FROM THIS DEPARTMENT, WORKING IN THE UNIVERSITY COLLEGE, LONDON, UNDER DR. O. J. WALKER.

(1) *Formation of methane during the electrolysis of potassium acetate and the mechanism of Kolbe's electrosynthesis:* (Transactions of the Faraday Society, 27, 1931).

(2) *The analysis of mixtures of hydrogen, methane and ethane:* (Journal of the Chemical Society, 1932).

(3) *Anode phenomena in the electrolysis of potassium acetate solutions. II—Discharge potential of the acetate ion:* (Transactions of the Faraday Society, 27, 1931).

(4) *Anode phenomena in the electrolysis of potassium acetate. Part III—Formation of methane:* (Transactions of the Faraday Society, 28, 1932).

DEPARTMENT OF BOTANY.

B. Sahni.

(1) *Insect galls on Picea Morinda Link, in Kashmir.* (Proc. Indian Science Congress, Madras, pp. 236-237, 1929).

Several years ago the author noticed that in the forests of the Poonch State (adjoining Kashmir) many of the spruce trees bore, at the tips of their vegetative shoots, small woody structures which even a trained botanist, on casual observation, would at once believe to be the female cones of a conifer, if he did not know their real nature. As a closer examination conclusively showed, these deceptive structures are really the tips of the vegetative shoots converted into cone-like galls as the result of insect attacks. The galls vary in length up to about 3-4 cm. When fully formed they show superficially a number of rhomboid more or less woody scales fitting together like the scales of a pine cone. From the centre of each rhomboid area projects an acicular process answering to the umbo. This process, however, is sometimes very long and at once betrays its foliar nature, for it is then exactly like a normal needle-leaf of *Picea*. The rhomboid scale at the base of each needle is nothing more than the hypertrophied leaf-base, which later becomes woody and closely simulates an ovuliferous scale.

During the months of May, June and July, 1928, the author was fortunate enough to be able to study the development of these galls and to some extent also of the insects (*Adelges himalayensis*), concerned in their formation, while he was spending a vacation at Gulmarg (Kashmir). Here *Picea Morinda* flourishes between the heights of 8-10,000 feet above sea-level, in spite of the fact that most of the trees are infected in the way above described, and some of them are loaded with galls. Oviposition appears to take place early in May, that is soon after the snow melts away, and the winged

insects leave the galls towards the end of July. At this stage the scales gape apart, somewhat in the way that the scales of a seed-bearing cone do to let the seeds out.

Galls of a similar kind are known to occur on *Picea excelsa* in Europe, where different insect species of the genus *Adelges* are concerned in their formation.

(2) *A bisexual cone of Picea Morinda Link:* (Proc. Indian Science Congress, Madras, p. 237, 1929).

In certain parts of Kashmir most of the trees of *Picea Morinda* are regularly attacked by insects (*Adelges himalayensis*), which convert the tips of the vegetative shoots into galls of various kinds (see paper No. 1). The abnormal bisexual cone here described was found in July 1928 at Gulmarg (8,500 ft. above sea-level) on a large tree bearing hundreds of cone-like insect-galls, similar in appearance to those known to occur in Europe on *Picea excelsa.* In a subsequent year (1931) over a dozen bisexual cones were collected from the same tree. The abnormality may possibly have something to do with an insect attack on an incipient male or female cone. There is no visible puncture, nor any other apparent sign of association with an insect. But of course any puncture caused by an ovipositor in a young cone would heal up during the growth of the cone.

The basal part of the cone bears a number of scales exactly like the transitional basal scales of a normal female cone. These are followed by a well defined zone of microsporophylls, most of which are well formed and contain normal pollen-grains. The distal half of the cone is again female, also normal in all respects. The cone is at about the stage of development when pollination takes place, and is about 3 cm. long. Normal pollination in *Picea* took place at Gulmarg during the week in which the abnormal cone was found. For figures see a paper in Journ. Ind. Bot. Society, X,

232-236, by L. N. Rao, who quotes the description from the author's preliminary paper.

Bisexual cones have not, so far as the author knows, been recorded in the genus *Picea*, although their occurrence in other conifers, *e. g.*, in *Pinus* and *Juniperus*, is well known.

(3) *On Asterochlaenopsis, a new genus of zygopterid tree-ferns from Western Siberia :* (Phil. Trans. Royal Society of London, Ser. B. Vol. 218, pp. 447-471, pls. 49-51, 1930).

About fifty years ago a Swedish engineer picked up a silicified stem near Semipalatinsk, in the Kirgis Steppes in Western Siberia. The fossil was cut transversely into several slabs, at least five of which ultimately found their way to Germany. One of the pieces reached the hands of K. G. Stenzel of Breslau and he described it in 1889 under the name *Asterochlaena (Clepsydropsis) kirgisica.* Another fragment came into the hands of A. Schenk, then Professor of Botany at Leipzig, and apparently in ignorance of Stenzel's fossil, he described it in the same year under a distinct name, *Rachiopteris Ludwigii* Leuckart et Schenk. The ultimate sources of the two specimens are so nearly identical that the present writer, in a paper published in 1919, suggested that they were probably pieces of one and the same stem. This suspicion was recently confirmed by a comparison of the type-specimens, which have been found to fit together. At the same time other fragments of the original fossil have been brought together, and several of the pieces have been examined for the first time in thin sections. This re-investigation has yielded the rather unexpected result that the fossil combines in itself the *Clepsydropsis*-like petiolar strand with a leaf-trace sequence resembling that of *Asterochlaena,* while the stem stele, hitherto practically unknown, is of a new type somewhat intermediate between those of *Asterochlaena* and *Ankyropteris.* In the structure of the leaf-trace at its point

of exit there is a close resemblance with the Osmundaceæ *Zalesskya* and *Thamnopteris*, from the Permian of Siberia.

Asterochlaenopsis thus constitutes, on the one hand, an interesting link between *Asterochlaena* and *Ankyropteris* and, on the other, an additional piece of evidence for a common origin of the Zygopterideae and Osmundaceae.

A further result of the present investigation touches the question of nomenclature and classification in the Zygopterideae. Some years ago, it was shown that two such distinct types of petiole as those of "*Clepsydropsis*" *australis* and *Ankyropteris Grayi* may be borne upon stems having an almost identical type of stele. And now we learn that two petioles, so closely similar as those of "*Clepsydropsis*" *australis* and the Siberian plant (hitherto regarded as a species of *Clepsydropsis*) actually belong to two generically distinct types of stem. Facts of this kind are a forcible reminder that however useful leaf characters may be in the classification of this family, they may sometimes be very misleading.

The discovery that rachises with typical "*Clepsydropsis*" bundles may be borne upon such different kinds of stems throws into suspicion the affinities of the fragmentary remains on which the genus *Clepsydropsis* was founded by Unger. A revision of part of the material originally described by Unger, and later by others, seems to indicate that Unger's *Clepsydropsis* belonged to a plant which was generically distinct from both the Siberian and the Australian zygopterids, and was possibly not a zygopterid at all*. In spite of their "*Clepsydropsis*" petioles, the claim of these two ferns to that generic name is thus seriously in question. One of them

* The author hints that it may after all have belonged to *Cladoxylon* a view to which even Bertrand has since reverted ; see Bertrand in *C. R. Acad. Sc. Paris*, 19 December 1932 ; and *Titres et Travaux Scientifiques*, Lille, 1933.

has now been transferred to the new genus *Asterochlaenopsis*; the other is being retained only very provisionally in Unger's genus. (See paper No. 12 below.)

(4) *The relation of the late Palaeozoic floras to the early Mesozoic floras:* (Proc. 5th International Botanical Congress, Cambridge, pp. 503-504, 1930).

Between the floras of the late Palaeozoic and early Mesozoic there is undoubtedly a striking contrast, but all the great Mesozoic groups seem to have already existed in the Palaeozoic. The difference consists chiefly in the relative strength of the groups.

An important link between the two is afforded by the recognition of Mesozoic Pteridosperms (announced by Dr. Hamshaw Thomas during the present session). The possible derivation of the Angiosperms from the Pteridosperms would greatly strengthen the connection. Well-defined Angiosperms certainly existed as early as the Jurassic; a presumably Jurassic dicotyledonous wood devoid of vessels had just been reported from India; the group may possibly be traced as far back as the Trias. Among other groups more or less definite connections may be traced between the Cordaitales and the Conifers (especially through the seed-structure of the Taxineae); while the Osmundaceae almost certainly arose from the base of a zygopterid stock, through Permian types like *Zalesskya* and *Thamnopteris* on the one side, and *Grammatopteris* and *Asterochlaenopsis* on the other.

An intensive study of the Triasso-Rhaetic floras of India and the Southern Hemisphere seems to promise much towards a solution of the problem, which has probably suffered from an inevitably rather one-sided approach, owing to our greater knowledge of the northern floras. In several of the Gondwana countries at least there is a closer resemblance between the late Palaeozoic and the Triassic floras, than between the latter

and the succeeding Rhaetic and Jurassic floras. If the Indian floras were classified independently of the European stratigraphical scale, the line of break corresponding to the Palaeozoic-Mesozoic limit would be drawn at the *top* of the Trias: this is the actual dividing line between the Lower and Upper Gondwanas.

In the Burghersdorp and Molteno beds of South Africa, in the Rhaetic of Tonkin, and in other regions plant-assemblages have been recorded which are composed of newer elements intermixed with persisting relics of the *Glossopteris* flora.

One of the most striking features of the transitional southern floras was the appearance of the forked Thinnfeldias (now called *Dicroidium*), which were sufficiently common and widely distributed to justify the name "Dicroidium Flora" and some of which are suspected to have Pteridosperm affinities.

The world-wide drought during the Trias undoubtedly supplied the impetus for the great wave of transformation which swept the vegetation of the globe at about this time of the earth's history.

(5) *Materials for a monograph of the Indian petrified palms :* (Proc. Academy of Sciences, United Provinces, Vol. I, pp. 140-144, December, 1931, Allahabad).

During the past thirteen years the author has brought together from various sources a quantity of silicified material which includes many new species referable to the artificial genus *Palmoxylon.* In the following list the first three species are the only ones previously described; the rest are all new and are based only on a portion of the material now in hand so far as it has been critically examined in thin sections. A fuller list, with detailed descriptions and figures, and includ

ing also several species represented in the Geological Survey's collections, is in course of preparation.

1. *Palmoxylon Blanfordi* Schenk (Bed of the Nerbuda).
*2. *P. Liebigianum* Schenk (near Sitalbaldi).
3. *P. ceylanicum* Unger (Ceylon).
4. *P. Wadiai* Sahni (Jammu).
5. *P. jammuense* sp. nov. (Jammu).
*6. *P. sundaram* sp. nov. (Saugor).
7. *P. indicum* sp. nov. (loc. unknown).
*8. *P. pondicherriense* sp. nov. (Pondicherry).
*9. *P. Edwardsi* sp. nov. (near Jubbulpore).
*10. *P. burmense* sp. nov. (Burma).
11. *P. compactum* sp. nov. (Burma).
12. *P. caudatum* sp. nov. (Burma).
13. *P. Krishna* sp. nov. (Sitalbaldi).
*14. *P. Mathuri* sp. nov. (Cutch).

(6) *On certain fossil epiphytic ferns found on stems of the palaeozoic tree-fern Psaronius:* (Proc. Indian Science Congress, Nagpur, p. 270, 1931.)

It is already known through the work of Stenzel and others that the zygopterid ferns *Ankyropteris scandens* and *Tubicaulis* sp. sometimes grew as epiphytes among the aerial roots of *Psaronius*. During a recent tour in Europe the author examined numerous specimens of *Psaronius* in various museums (Dresden, Chemnitz, Vienna, Paris, Prag, etc.). The impression he gained was that epiphytic ferns are much more common than is generally known, on specimens of *Psaronius* from

*An asterisk denotes the presence of purely fibrous bundles in the ground tissue.

Saxony and Bohemia. The *Tubicaulis* is perhaps more commonly seen than the *Ankyropteris*, but the two may occur together. The author exhibited a specimen showing both genera on one stem of *Psaronius*, and another with as many as 7 epiphytic stems of *Tubicaulis*, and also a petiole of *Anachoropteris* among the roots of a *Psaronius*. A specimen of *Psaronius* in the Dresden museum includes not only *Tubicaulis* and *Anachoropteris* but also another (poorly preserved) fern, probably a *Grammatopteris*. Thus as many as four distinct genera of the family have been observed as epiphytes on *Psaronius*.

These facts seem to indicate that during the Permian period, when the above-named genera flourished in Central Europe, the climatic conditions were conducive to the growth of a dense and luxuriant vegetation, comparable to the tropical forest of the present day.

The fact that these epiphytic stems are sometimes found far in the interior of the root-zone of *Psaronius* shows conclusively that at least those roots which lie externally to the epiphytes were not intra-cortical, but free aerial roots.

(7) *Supplementary note on 'Revisions of Indian Fossil Plants, Part II. Coniferales (b. Petrifactions*, 1931) : (Records, Geol. Surv. India. Vol. LXV, Part 3, pp. 441—442, 1931).

In this note, written in reply to a criticism, the author gives reasons for not including the two species *Dadoxylon indicum* Hold. and *D. bengalense* Hold. in his list of Indian petrified conifers. He shows that these two fossil woods from the Lower Gondwanas are more probably cordaitalean than coniferous. In *D. indicum* the large pith and paired leaf-traces weigh distinctly in favour of a cordaitalean alliance; in *D. bengalense*, the pith is not preserved but the ephemeral character of the leaf-traces seems to go against a reference to the

Araucarineae, the only coniferous family with which confusion is possible.

Similarly, the species *Araucarioxylon Robertianum* Schenk seems to have been founded, at least in part, on a cordaitalean and not a coniferous wood. Of the four specimens (from three widely separated localities) which were united under this name, the one from Asansol may well have been specifically identical with some large petrified trees recently discovered there during excavations on the East Indian Railway. (See paper No. 9 below).

Cedroxylon Hermanni Schenk is a very imperfectly known wood, of which even the genus is uncertain.

(8) *On the structure of Zygopteris primaria Cotta sp., and on the relation between the genera Zygopteris, Etapteris and Botrychioxylon):* (Phil. Trans. Royal Society of London, Ser. B. Vol. 222, pp. 29-45, plates 6-8, December, 1932).

Zygopteris primaria (Cotta) Corda was one of the first known Zygopterideae, originally described over a century ago, but our knowledge of it was hitherto confined to the petiole, and that too was defective. In the present paper the structure of the stem, leaf-trace and root is described for the first time, from an old specimen in the Cotta Collection at Berlin, which had been overlooked for many years. At the same time the type-specimen has been re-examined, and the structure and mode branching of the petiolar strand has been elucidated.

In habit *Z. primaria* was a large tree-fern ; the slender leaf-bearing axis was held erect by a thick supporting armour of petiole bases and adventitious roots. The young leaves and aphlebiae were clothed in a dense ramentum of scales.

The investigation of the anatomy has revealed facts of a very unexpected nature. It has been ascertained beyond doubt that *Z. primaria had typical Etapteris petioles, borne*

upon a stem having the Botrychioxylon type of stele; the leaf-trace sequence and root-structure were also essentially as in B. paradoxum. Had the Berlin specimen been known earlier, neither of the genera *Botrychioxylon* (Scott 1912) and *Etapteris* (Bertrand 1907) would have been founded. Indeed, the creation of the latter genus was due entirely to an error of observation, for even in the type-specimen the petiolar bundles are typically *Etapteris-like*, as Cotta showed a century age, and not >——< shaped with hooked antennae, as we have been accustomed to believe, after Paul Bertrand, since 1909. The mode of branching of the petiolar strand is also identical in every respect with that of *Etapteris*.

These facts raise questions of nomenclature and relationships which are briefly discussed. Both *Etapteris* and *Botrychioxylon* are no doubt firmly linked with *Zygopteris*; and in ordinary circumstances would be merged in Corda's much older genus. But recent experience within the Zygopterideae imposes caution against a merging of the genera at the present stage. For while, on the one hand, petioles of an identical type have actually been found attached to stems of two different kinds ("*Clepsydropsis*" *australis* and *Asterochlaenopsis kirgisica*), on the other, stems having an almost identical stelar structure are known to have borne petioles of two distinct types (*Ankyropteris Grayi* or *A. scandens* and "*Clepsydropsis*" *australis*).

But while, as a precautionary measure, the genera *Botrychioxylon* and *Etapteris* must for the present be maintained, in the opinion of the author it would be surprising if the petiole of *B. paradoxum* should eventually prove to be of a type distinct from *Etapteris*, or if *Etapteris* petioles should later be found attached to stems essentially unlike those of *Z. primaria* or *B. paradoxum*.

Thus the old and once extensive genus *Zygopteris*, after many vicissitudes, will probably emerge once more as the largest and most important of the Zygopterideae.

(9) *Dadoxylon Zalesskyi, a new species of Cordaitean trees from the Lower Gondwanas of India*: (Proc. Indian Science Congress, Bangalore, pp. 321-322, 1932; the full paper will appear in Rec. Geol. Surv. India, Vol. XVI, Part 4).

Under this name it is proposed to describe a silicified stem from near Asansol, in the Raniganj Coalfield, Bihar. The fossil was kindly sent to the author by Professor K. K. Mathur of Benares Hindu University, to whom his sincere thanks are due.

Silicified wood of the *Dadoxylon* type has long been known to occur in the Raniganj area, and in recent years large tree-trunks have been discovered near Asansol on the E. I Railway (Rec. Geol. Surv. India, Vol. 58, pp. 75-79). The Geological Survey of India have reason to believe that this fossil wood occurs at a definite horizon in the Raniganj Series (C. S. Fox, 1928, Rec. Geol. Surv. Ind. Vol. 60, Pt. 4). The presumption is that all these trees were Cordaitean (not Araucarian), and most, if not all, of them may have belonged to one species. But owing to poor preservation and especially owing to the fact that the pith and primary wood have not been found preserved in any of them, it has not so far been possible to determine their affinities.

The interest of the present specimen lies in the fact that the pith and primary xylem are preserved both in the main axis and in several lateral branches. The structure shows that the stem belonged to a Cordaitalean tree of the Gondwana type. The close resemblance both in external characters and in the structure of the secondary wood with the large trees from Asansol supports the view that the latter also belong to

D. Zalesskyi, but this cannot be proved unless the pith and primary structure is shown to be the same.

The pith is large and cylindrical, not discoid as in the northern Cordaiteae. The protoxylem is simple, not showing any parenchyma islands such as Miss Holden described in *D. indicum* (Ann. of Bot., Vol. 31, pp. 315-320). From *D. bengalense* (Ann. of Bot., Vol. 31, pp. 321-324) the new species differs in the absence of any *Callixylon*-like grouping of the radial pits on the secondary tracheids, and in other respects.

D. Zalesskyi is thus distinct from both the previously described Indian species, which are said to be of Barakar (= Lower Permian) age. If, as is most probable, the present specimen comes from the same geological horizon as the numerous other specimens found in the Raniganj area, its age would be distinctly younger, for it would correspond to the Raniganj Stage, which is generally regarded as late Permian.

The new species is named after the eminent Russian geologist and palaeobotanist, Professor M. D. Zalessky.

(10) *A petrified Williamsonia* (*W. Sewardiana, sp. nov.*) *from the Rajmahal Hills, India*. (Mem. Geol. Surv. India, Palaeontologia Indica, New Ser., Vol. XX, Mem. No. 3, pp. 1-19, pls. I-III, 1932).

The present work embodies the reconstruction of one of the first-known Indian fossil cycads.

Pinnate fronds of the *Ptilophyllum* type have been known from various upper Gondwana localities in India for nearly a hundred years. In several instances *Williamsonia* flowers or armoured cycadean stems have been found associated with such leaves. About thirty years ago Professor Seward showed that some leaves resembling *P. cutchense* were actually attached to one of the stems from the Rajmahal Hills which he subse-

quently named *Bucklandia indica*, Sew. In the present paper the author describes a unisexual (female) *Williamsonia* fructification which proves to have belonged to the same plant as *Bucklandia indica* and *Ptilophyllum* cf. *cutchense*. For this plant the new name *Williamsonia Sewardiana* is now suggested.

The fructification is described in detail and the evidence for its attribution to *Bucklandia indica* is also stated in full. An attempt has been made to represent the plant as it probably appeared in life. The habit must have been very like that of a miniature *Cycas*, with the flowering shoots projecting laterally from the columnar trunk, like the vegetative buds in the living genus. The flowering shoots were probably shed periodically and may also have served for vegetative propagation like the buds of *Cycas*.

In view of our knowledge of the anatomy of its leaves, stem and fructification *Williamsonia Sewardiana* is the best known species of the genus.

The structure of the fructification closely resembles that of *W. scotica*. The undoubted affinity between these two geographically far separated species affords additional proof of a relation between the Indian Rajmahal flora and the Jurassic flora of N. W. Europe.

The evidence at present available supports the view that the Rajmahal series probably extended upwards into the middle Jurassic.

(11) *Homoxylon rajmahalense gen. et. sp. nov., a fossil angiospermous wood, devoid of vessels, from the Rajmahal Hills, Behar:* (Mem. Geol. Surv. India, Palaeontologia Indica, New Ser., Vol. XX, Mem. No. 2, pp. 1-19, pls. I-II, 1932).

The new genus *Homoxylon* is based upon a solitary block of secondary wood found long ago at an unknown locality in the Rajmahal Hills, Behar. The age is reported by the Geological Survey of India to be that of the Rajmahal series (Upper Gondwana) which is undoubtedly Jurassic, but as the exact locality is not known the age cannot be regarded as quite certain.

The structural interest of the wood lies in the fairly close resemblance with the modern homoxylous Magnoliaceae, and it is provisionally referred to that group.

There are no true vessels; the structure of the medullary rays is essentially like that in the Homoxyleae; the pitting of the tracheids in the fossil recalls that of some Magnoliaceae more closely than it does that of any other known plants. Comparisons have also been made with some fossil woods showing more or less marked affinity with the Magnoliaceae, *e. g. Trochodendromagnolia* Zander, *Pataloxylon* Sahni, *Aptiana* Stopes, *Cantia* Stopes. Of these the only genera devoid of true vessels are *Trochodendromagnolia* from the Tertiary of Central Europe and *Pataloxylon* from the Tertiary of Queensland.

If the Jurassic age of the Rajmahal fossil could be definitely establised it would be a fact of considerable theoretical interest. The theory according to which the Angiosperms have been derived from some gymnospermous group like the Bennettiales through the Magnoliaceae or some related extinct family would thereby gain distinct support.

(12) *On the genera Clepsydropsis and Cladoxylon of Unger, and on a new genus Austroclepsis:* (New Phytologist, Cambridge, Vol. XXXI, pp. 270-278, 1932).

Reasons are given for the view that the southern zygopterid generally known as *Clepsydropsis australis* is not a *Clepsy-*

dropsis, in spite of its petiolar structure, but represents a new and distinct genus. For this the name *Austroclepsis* has been proposed.

Austroclepsis is distinguished from other Zygopterideae by a combination of *Clepsydropsis*-like, *Ankyropteris*-like and *Tempskya*-like characters. The petiolar bundle is of the *Clepsydropsis* type, but the stem stele and leaf-trace sequence agree with the corresponding organs in *Ankyropteris Grayi* or *A. scandens*, except that the leaf-trace has no adnate axillary strand. The repeatedly forked leaf-bearing axes are bound together by adventitious roots into a *Tempskya*-like false stem. The only known species is *A. australis* (E. M. Osb.) Sahni comb. nov. With the possible exception of a slender *Botrychioxylon*-like axis epiphytic among its roots, *Austroclepsis* is the only genus of Zygopterideae yet recorded from the southern hemisphere.

There is some evidence that in their habit and mode of branching the Thuringian leaves referred to *Clepsydropsis* differed considerably from those of both the Siberian and the Australian zygopterids and, indeed, from any zygopterids at present known.

Even if *Clepsydropsis* Unger was a zygopterid (which on present evidence seems uncertain) it should not be accepted without hesitation as co-generic with any other member of that family. (See footnote, p. 44.)

To avoid confusion it is desirable that the name *Clepsydropsis* be used in the sense of a form genus, that is, it should be reserved for rachises of unknown attribution containing vascular bundles of that type. The presence of clepsydroid strands in the leaves is not by itself a proof that the plants in which they are found belong to the same natural genus.

(13) *On a palaeozoic tree fern, Grammatopteris Baldaufi (Beck) Hirmer, a link between the Zygopterideae and Osmundaceae:* (Annals of Botany, Vol. XLVI, No. CLXXXIV, pp. 863–877, October, 1932).

This paper is based on a reinvestigation of the type-specimen of *Protothamnopteris Baldaufi*, Beck, a silicified tree-fern from the Lower Permian of Saxony. Hirmer's reference of the species to the genus *Grammatopteris* is confirmed, and the affinities of the latter genus are discussed.

Reasons are given for the view that *Grammatopteris* should be removed from the Botryopterideae: the structure clearly shows that the affinities lie in the direction of the Zygopterideae and the Osmundaceae. In its stem anatomy *G. Baldaufi* resembles certain members of both these families, but in its foliar characters it readily falls into line with the Zygopterideae. On the whole, so far as the vegetative characters can serve as a guide, the affinity with the latter family appears to the author to be somewhat the stronger.

Grammatopteris is a synthetic type of great interest, and affords an important piece of evidence in favour of Kidston and Gwynne-Vaughan's theory of a common origin for the Osmundaceae and Zygopterideae. That this genus is both simpler in structure and geologically older than the allied genera *Thamnopteris* and *Zalesskya*, probably indicates that it is not far removed from the primitive Osmundaceous stock. At the same time the simple bipolar strand, as well as the stelar structure, probably mark it out as a primitive type of zygopterid.

The discovery of *Grammatopteris* in the Lower Permian beds of Chemnitz provides a further link with the allied flora of Autun in Central France, which is roughly contemporaneous with that of Saxony.

(14) *Staminal movements in Gerbera lanuginosa :* (Journal of the Indian Botanical Society, Vol. II, pp. 241-242, 1932).

The author records the occurrence of staminal movements in a common N. W. Himalayan plant, *Gerbera lanuginosa* (Compositæ), which is widely distributed in the Punjab Hills at altitudes between 5,000 and 7,000 feet above sea-level.

The movements are remarkably like those well-known to occur in *Centaurea*, and the mechanism is the same, namely, a shortening of the filaments owing to diminished turgidity of their cells. When the disc floret is ready to be stimulated the tip of the anther tube is closed by the five valves of the tube meeting in a point at the top. The staminal column presents exactly the same subulate, very slightly curved, appearance as in *Centaurea*. If the tip is gently tickled the staminal column becomes visibly shorter, at the same time swaying gently to one side or the other in the same manner as in *Centaurea*. The tip of the anther tube is then seen to be covered by a mass of pollen ; if one observes the process carefully with a strong pocket lens, the fairly large pollen grains are seen forced out in strings through the five chinks between the valves of the anther tube.

There is a slight difference from *Centaurea* in the structure of the style. In *Centaurea* the style is covered by upwardly pointed hairs and at a point below the bifurcation of the stigmas there is a ring of specially long bristles, which aid in sweeping the pollen up through the anther tube. In *Gerbera* there is no such bottle-brush arrangement. The opposed stigma lobes are together slightly thicker than the style and serve merely as a piston to push the pollen forward. The lower parts of the filaments are of a yellow orange colour and under the microscope their surface appears papillate.

The author is not aware that these movements have previously been recorded in the genus *Gerbera*.

(15) *Anatomical proof of the Cycadophyte affinities of Tæniopteris spatulata McCl:* (Proc. Indian Science Congress, Bangalore, p. 322, 1932).

Some silicified blocks from the Rajmahal Hills (Santal Parganas, Bihar) are largely composed of petrified leaves of *Tæniopteris spatulata* McCl. This is a characteristic Jurassic fossil with a wide geographical distribution, which has hitherto been found only as impressions, and of which the affinities are therefore not quite certain.

Thin transverse sections of the leaf show, in the rather broad midrib, a row of mesarch collateral bundles of typical cycadean structure.

Longitudinal sections of the lamina, cut parallel to the midrib show a horizontal series of bundles (the lateral veins) each placed in the middle of a girder of mechanical tissue.

The general belief that *T. spatulata* was the leaf of a fossil cycad and not of a fern is strengthened by the analogy of *T. vittata*, an allied species of frond which most probably belonged to *Williamsoniella coronata*. The present work provides the first anotomical evidence in support of this view.

(16) *Palmoxylon Mathuri, a new species of petrified palms from Cutch, Western India:* (Proc. Indian Science Congress, Bangalore, p. 322, 1932).

A silicified block from Laknipur in Cutch kindly sent to the author for investigation by Professor K. K. Mathur of the Geological Department, Benares Hindu University, is here described under the name *P. Mathuri* sp. nov.

The preservation is excellent. In the ground-tissue scattered round fibrous bundles are present. The parenchyma is interesting on account of its markedly lacunar character, the individual cells as seen in cross-sections of the stem being

narrow and much elongated in the horizontal direction, with very large interspaces.

Geological age, probably Cretaceous.

(17) *Conites Hobsoni, a new species of fossil ovuliferous cones from the Rajmahal Series, Bihar:* (Proc. Indian Science Congress, Bangalore, pp. 322-323, 1932).

The silicified leaves of *Tæniopteris spatulata* described in paper 15 above are associated with numerous vegetative shoots of *Brachyphyllum* and some small silicified ovuliferous cones here described as *Conites Hobsoni* sp. nov.

There is some evidence, although definite proof is still lacking, that these cones were borne upon the associated *Brachyphyllum* shoots which externally resemble *B. mamillare.*

So far as it is known at present the cone-scales were simple; a single ovule was placed on the adaxial side of each scale. The anatomy of the cones is described in detail.

It has been suggested by others that at least some species of *Brachyphyllum* were conifers of araucarian affinity. This suggestion would find some support if the attribution of *Conites Hobsoni* to the associated shoots is confirmed.

(18) *The wood anatomy of a homoxylous dicotyledon Tetracentron sinense Oliv.* . (Indian Science Congress, Patna, Jany., 1933).

In a recent paper (Palaeont. Indica. XX, 1932; see No. 11 above) on a fossil angiospermous wood, devoid of vessels, from the Rajmahal Hills, Behar, the author described the anatomy of what is probably an extinct member of the homoxylous dicotyledons allied to the modern genera *Drimys*, *Trochodendron*, *Zygogynum* and *Tetracentron.* For a comparison of the fossil type, to which the new generic name *Homoxylon* was given, with the modern Homoxyleæ, he had at his disposal at the time material of only the

first three genera. Through the kindness of Professor H. Harms of Berlin, he has now been able to examine also the fourth genus, *Tetracentron*, of which the only known species is *T. sinense Oliv.*, confined to Western and Central China.

Our knowledge of the wood anatomy of *Tetracentron* is confined to brief accounts by Harms (Ber.d.d.Bot. Ges. XV, 1897), Thompson and Bailey (Mem. N. Y. Bot. Gard., VI, 1916; Ann. of Bot. XXXII, 1918), Solereder (Syst. Anat.d.Dicot., 1899) and Van Tieghem (Journ. de. Bot. XIV, 1900)*. Several other authors have entered into the theoretical bearings of the facts, but the only botanists who have made any contributions to our knowledge of the structure itself are those named above. Harms first announced that *Tetracentron* wood is devoid of true vessels, and compared it with that of *Trochodendron*.

The only figures yet published* are those by Thompson and Bailey, who described the wood of both root and stem and also the structure of the petiole.

The present investigation shows that *Tetracentron* resembles *Trochodendron* more closely than it does the other two genera. In both *Tetracentron* and *Trochodendron* the growth-rings are sharply marked and the autumn wood is strongly developed. On the radial walls of the wider tracheids the scalariform type of pitting predominates. Both these genera are distributed in the Far East. On the other hand, *Drimys* and *Zygogynum*, which occur in the Australasian and American region, have very faintly marked rings of growth, the autumn wood is very poorly developed, and the radial pitting of the wider tracheids is predominantly multiseriate.

It is perhaps a fact of some significance that the fossil wood from Behar is both geographically and structurally nearer to *Tetracentron* and *Trochodendron* than to the Pacific genera.

* Since the above paper was communicated Mathiesen has published important facts and figures relating to *Tetracentron* and an extinct new genus which he has named *Tetracentronites*. Medd. om. Granland, Vol. 85, 1932.

In his paper on *Homoxylon* the author has already touched upon the theoretical bearing of the Homoxyleae, in relation to the possible derivation of the primitive angiosperms from the Bennettitales.

(19) *Explosive fruits in Viscum japonicum Thunb:* (Proc. Indian Science Congress, Patna ; for the full paper see Journal of the Indian Botanical Society, Vol. XII, pp. 96—101, 1933).

It is generally believed that the seeds of the genus *Viscum* are dispersed by birds, who eat the viscid pulp and leave the seeds sticking to the branches of trees on which they rub their beaks. This is certainly true of *V. album* but not of *V. japonicum*, which grows abundantly on *Quercus incana* in some parts of the Western Himaslayas, and which I have recently had under observation at Lansdowne (Garhwal). The minute obovoid fruit (scarcely 2 mm. long) is quite inconspicuous and retains it green colour. It ripens during the rainy season, and then becomes somewhat translucent, so that the seed is just visible through the pericarp in the broader distal part of the ovary. Dispersal takes place by a violent ejection of the seed from the top end of the ovary which bursts as the result of increased turgidity. Twigs of *V. japonicum* bearing ripe fruits, if disturbed by shaking in the wind, throw off the seeds to a distance of over two feet. Ripe fruits attached to twigs, left immersed in a basin of water, were found to have ejected their seeds to a distance of several inches under water.

The structure of the "fruit", so far as it relates to the explosive mechanism, is very similar to that in the allied genus *Arceuthobium* as described by Johnson (Ann. of Bot., II, 137-160, 1888) and by Peirce (Ann. of Bot. XIX. 99-113, 1905). In a median longitudinal section the fruit of *V. japonicum* exhibits a deceptive resemblance with a *Cycas* ovule. There is a double set of vascular bundles ; the outer set runs in

the perianth, while the inner is closely in contact with the inner ends of the viscid cells. These inner bundles are no doubt specially concerned with supplying the water which swells the viscid layer shortly before the ejection of the seeds. A section cut from material which had been kept for several months in formalin-alcohol was placed on a slide in water; it was noticed that the expansion of the viscid layer began at the thicker distal end, which became raised in the form of a dome pressing the apex of the fruit upwards. This pressure would gradually be communicated to the more proximal parts of the fruit, and as the lateral and basal parts of the viscid layer also expand, there would be an all-round compression of the seed which would only be relieved by an apical rupture, when the seed would be shot out like a bullet from a gun. In *Arceuthobium* both Johnson and Peirce figure the viscid tissue as a continuous dome-shaped cap to the seed. If the sections figured by these authors are really median, *V. japonicum* differs from *Arceuthobium* in the fact that the viscid layer is perforated at the top. Another point of difference, already noticed above, is the absence, in *Viscum*, of any well defined abscission layer. As in *Arceuthobium*, the radicle of the tiny ill-developed embryo projects from the starch-filled endosperm as a hemispherical knob which is capped by the remains of the ovarian papilla in the form of an inverted funnel.

B. Sahni and A. R. Rao.

(20) *On a collection of fossil plants from the Rajmahal Hills, Bihar:* (Proc. Indian Science Congress, Bangalore, pp. 323-324, 1932; for the full paper see Journal and Proc. Asiatic Society of Bengal, Vol. 27, pp. 183—208, plates 11—16, Calcutta).

In 1927, 1930 and 1931 parties from the Botanical Department of the Lucknow University visited several localities in the Rajmahal Hills, Bihar, where plant-bearing beds of Juras-

sic age, interstratified with volcanic lavas, are exposed in numerous patches. The chief localities where fossil plants were collected are near Mirzachowki, near Sakrigali Ghat, Onthea and near Amrapara. The following is a provisional list of the species collected:—

EQUISETALES ... *Equisetites rajmahalensis.*

FILICALES ... *Sphenopteris Hislopi* O. and M.
Sphenopteris sp.
Coniopteris hymenophylloides Brongn.
Marattiopsis macrocarpa Morris sp. (including fertile leaves).
Gleichenites gleichenoides.
Cladophlebis indica O. and M. sp. (also a fertile specimen).
Rhizomopteris sp.

CYCADOPHYTA ... *Williamsonia* sp., cf. *W. Sewardiana* Sahni.
Ptilophyllum cf. *P. cutchense* Morris.
P. acutifolium O. and M. sp.
P. tenerrimum Fst.
Otozamites parallelus Fst. sp.
Zamites proximus Fst.
**Pterophyllum incisum* sp. nov.
Pterophyllum sp.
Dictyozamites falcata Morris sp.
D. indica Fst. sp.
**D. Hallei* sp. nov.
Taeniopteris spatulata Mc Cl. sp.
T. McClellandi O. and M. sp.
T. (*? Nilssonia*) spp.
Nilssonia (*? Anomozamites*) *fissa* Fst. sp.
N. Morrisiana O. and M. sp.
N. princeps.
Seeds, probably of *Nilssonia* sp.

CONIFERALES	...	*_Ontheodendron Florini_ gen. et. sp. nov. (megastrobili.)
		Araucarites sp.
		Elatocladus conferta O. and M. sp.
		E. tenerrima Fst. sp.
		_E._ spp.
		Brachyphyllum expansum Sternb. sp.
INCERTAE	...	_Podozamites_ sp.
		cf. _Cycadolepis._
		Indeterminable fragments, including silicified wood.

The three species marked * are new to science.

S. K. Mukerji.

(1) *Stratification of nitrates in natural soils of Lucknow in the form of Liesegang rings and the significance of this phenomenon in agricultural practice:* (Proc. Indian Science Congress, Madras, pp. 251-252, 1929).

An intensive study of the soil conditions of Lucknow is in progress. Some of the principal edaphic and climatic factors which exercise profound influence on the growth of plants *e. g.*, water content, organic content, nitrate content, carbonate content, hydrogen-ion concentration ; temperatures of the soil and of air at different levels, etc., are being investigated.

In the course of this work, it has been found that the nitrate content of certain soils, that have been examined so far, behaves in a remarkable manner. Contrary to the general views held with regard to distribution of nitrates at successive depths of the soil, it has been discovered that the nitrates occur in the soils investigated, at different horizons in the form of Liesgang rings. The causes which may contribute in bring-

ing about this kind of stratification of nitrates in soils can be grouped into three main categories, *viz.* :—

(*a*) possible occurrence of nitrifying bacteria in different strata corresponding to those in which the nitrates occur ;

(*b*) possible distribution of laterals bearing nodules on the root-system of leguminous plants which may enrich definite layers of the soil with nitrates, and lastly ;

(*c*) colloidal adsorption of nitrates by some soil colloids.

An investigation of the electrical charges borne by the nitrate—, and non-nitrate-bearing strata of the soil has revealed the presence of positively charged bodies in nitrate-bearing strata and negatively charged ones in the non-nitrate-bearing layers.

A theory is advanced that the stratification of nitrates in the soil is brought about by colloidal silica taking up a positive charge by uniting with electrolytes such as salts of Potassium and Sodium and in its turn absorbing the negatively charged nitrate-ions.

If this phenomenon is found to occur widely in agricultural lands, then for nitrate-demanding crops like wheat, deep tilling will have to be resorted to by the Indian agriculturists.

(2) *The hydrogen-ion-concentration of the soil as a factor of vital importance in governing the distribution and growth of plants :* (Proc. Indian Science Congress, Madras, pp. 252, 1929).

Since Sörensen showed in 1909 how important a factor the hydrogen-ion concentration was in the domain of biology, including plant and animal physiology, numerous researches have been published from time to time bearing on the subject. The

works of Wherry, Olsen, Clark, Arrhenius, Atkins and Salisbury among others, have materially advanced our knowledge with regard to the important part played by hydrogen-ion concentration in governing plant distribution and in modifying plant growth.

As a result of soil analyses of over three hundred soil samples supplemented by physiological experiments, the author has observed that hydrogen-ion concentration of the soil exercises a profound influence on the distribution and growth of plants. It has been found that there is a range of hydrogen-ion concentration within which a certain species will grow. Too high specific acidity below the range of pH4 and too high specific alkalinity above pH8 in the medium in which a plant grows are found to act as limiting factors, so much so that they tend to completely retard the growth of the species in question and may in the end be instrumental in the disappearance of the plant altogether. Certain plants under conditions of physiological experiments show a definite gradation in the increase of height, fresh weight, and dry weight of their aerial shoots with progressively diminishing hydrogen-ion-concentration. From these experiments it appears that the maximum growth is attained nearer the neutral point. It is probable that absorption of ions of various salts which are required for the healthy growth of a plant may take place actively at the neutral point, thus resulting in more vigorous growth in this region of hydrogen-ion concentration.

Then again, the hydrogen-ion concentration has been found to exercise a marked effect on the distribution of species in nature. Plants which favour acid conditions will not grow where the soil is becoming progressively alkaline and *vice versa.*

(3) *Bathymetrical Survey of the Dal Lake of Kashmir, with special reference to the penetration of actinic rays to different depths of water and their effect on the incidence of*

vegetation: (Proc. Indian Science Congress, Bangalore, pp. 328-329, 1932).

A survey of the Dal Lake was made to find out its depth in different parts. Numerous charts were prepared showing depth and vegetation. During summer (June and July), the deepest parts of the Dal seldom exceed twenty feet, while those of Lake Manasbal, 45-50 feet.

The measurement of light intensity (actinic rays) was made at different depths of the Dal during the growing season, *i. e.*, in the summer of 1929. For this purpose, the author constructed a special apparatus which is a kind of photometer. The potassium iodide method was not employed deliberately, owing to its many inherent and serious defects as pointed out by Pearshall.

The percentage of illumination at different depths varies according to the degree of sedimentation and density of vegetation. In clear and still water, the light intensity measured 33·3 per cent at a depth of one foot, 15·2 per cent at 2 feet, 8·9 per cent at 3 feet and 1·2 per cent at 15 feet. In Manasbal Lake, however, light intensity measured 8·2 per cent at 16 feet, 38·2 per cent at 5 feet and 75 per cent at one foot. The macrophytic vegetation in the Dal Lake is found up to a depth of 17 feet whereas in the Manasbal Lake, of which the water is six to eight times clearer than in the Dal (judged from the percentage of light penetrating different depths) this type of vegetation extends to a depth of about 25 feet. By vegetation the author means *macroscopic* vegetation and not *microscopic*. The plants that can grow to such great depths are *Chara fragilis, Nitella acuminata, N. dispersa, N. hyalina, Nitellopsis obtusa, Ceratophyllum demersum, Potamageton crispus, P. pectinatus, P. lucens, and Myriophyllum verticillatum.* These plants appear to possess great powers of tolerating very low intensities of light, although they are fully capable of growing in very bright light. There are other

plants such as *Nymphaea alba*, *Nelumbium speciosum*, *Euryale ferox*, *Potamogeton indicus* and other members of the floating leaf association which demand a higher percentage of illumination at the time of the commencement of vegetative activity after the winter lull.

The vegetation is practically non-existent or scanty in those parts of the Dal where plenty of sedimentation occurs. This is partly due to poor penetration of light.

In the Reed-swamp zone of *Carex*, *Phragmites* and *Typha*, the penetration of light is much poorer, owing to the density of both benthos and free-floating vegetation.

(4) *On the genus Artemisia—its species, varieties and ecads as found in Kashmir :* (Proc. Indian Science Congress, Bangalore, p. 329, 1932).

The author has made a special study of the genus *Artemisia* and has collected as many as eighteen species from various localities and distant mountainous regions of Kashmir. When working at the Kew Herbarium, he identified the following species :—*Artemisia salsoloides*, *A. dracunculus*, *A. glauca*, *A. parviflora*, *A scoparia*, *A. maritima*, *A. brevifolia*, *A. Tournefortiana*, *A. amygdalina*, *A. Roxburgiana*, *A. vestita*, *A. laciniata*, *A. Sikrorum*, *A. Moorcroftiana*, *A. Falconeri*, *A. absyntheum*, *A. Sieversiana and A. vulgaris.*

An ecological and taxonomic study of *Artemisia maritima* was made in the Gurez Valley and the Nanga Parbat Region of Kashmir in the summer of 1929. It was found that most of the hill sides were densely clothed with at least three varieties and ten habitat-forms of this species. Natural regeneration by seedlings takes place extensively. It appears that the seeds lie dormant only for a short time and they germinate during the same season. Further development of seedlings is arrested owing to heavy fall of snow, under which seedlings in

different stages of growth remain buried throughout the winter.

The yield of santonine from this plant is found to vary with the climatic conditions prevailing at the time of collection of the flower buds. A spell of dry period gives higher yield while collection made during wet weather shows a marked drop of santonine content.

As a result of the author's work at Kew, he believes that the varieties of *Artemisia maritima* found extensively in Kashmir and the trans-Himalayan region (Deosai plains) are quite different in most habitats from those found in different parts of Russia, from where the main bulk of the santonine of commerce is obtained.

Sometimes other species of *Artemisia*, especially *A. vulgaris* and *A. brevifolia*, have been commonly mistaken for the true *A. maritima*.

(5) *The commercial plantation and exploitation of Indian medicinal plants and the need for the compilation of an Indian Pharmacopoeia:* (Proc. Indian Science Congress, Bangalore, p. 333, 1932). (Published by the Indian Press, Allahabad, pp. 1-12, 1930).

It is well known that a very large percentage of people in India living both in rural areas and in towns have to take recourse to the indigenous systems of medicine, knowing very well that the Hakeems and Vaids of the present day lack that intensive and methodical training in the methods of treatment which has been evolved as a result of scientific investigations and researches in the domain of Western medical science. The poverty-stricken classes of the rural and urban populace are too poor to buy the scientifically prepared but costly drugs of the West. It is, therefore of the utmost importance that pure, reliable and cheap pharmaceutical preparations made from indigenous medicinal plants should be placed on the market on

a large scale for the benefit of the masses. For this purpose an extensive survey of the Indian drug flora should be undertaken at an early date and a large number of regional maps should be prepared showing the distribution of medicinal plants in wild localities in different parts of India. Such regional surveys carried out by expert botanists will result in the compilation of an up-to-date drug flora of India.

A crying need of the times is the establishment of experimental drug farm in suitable centres. Plantations of medicinal herbs should receive unstinted support from the Government and the public alike, for these farms will ensure a constant supply of medicinal herbs not only to Vaids and Hakeems but also to various research workers in the field of Pharmacology. In this connection, the author cannot over-emphasize the fact that many more workers in Pharmacology should interest themselves in the investigation of the pharmacological properties of the Indian medicinal plants than are doing at present, so that their investigations may, in the near future, lead to the compilation of an Indian Pharmacopoeia. There is also a great need for regulating co-ordinated research work along definite pre-arranged lines by a committee of experts consisting of botanists, chemists, physiologists and pharmacologists.

The vernacular nomenclature of Indian medicinal plants is in a hopeless mess. Early steps should be taken to standardize nomenclature, and the aim should be to assign one definite name to each species of medicinal plant, by which it will be known throughout the length and breadth of India.

The author's object in submitting this paper is to stimulate interest in this branch of botanical science.

(6) *On the distribution of freshwater plants in India:* [Indian Science Congress, Patna, 1933].

It was generally believed that freshwater being an uniform habitat, the floristic composition of the aquatic vegetation of various inland lakes, jheels and rivers in India would show a great similarity. But having worked for the last 15 years on the correlation between the freshwater flora and the "Climatic Complex" of the region especially in respect of the temperature, humidity, and pH relations, the author considers that from this point of view, the freshwater plants may be grouped into three main categories :—

TROPICAL FORMS—*e. g. Jussieua repens, Trapa bispinosa, Neptunia oleracea, Lagarosiphon Roxburghii, Blyxa Roxburghii, Otellia alismoides, Wolffia sp. Eichhornia crassipes.*

TEMPERATE FORMS—*e. g. Alisma plantago, Triglochin palustre, Trapa natans, Salvinia sp., Hippuris vulgaris, Callitriche verna, Myriophyllum verticillatum, Hydrocharis morsus-ranae, and Sparganium ramosum.*

COSMOPOLITAN FORMS—*e. g. Hydrilla verticillata, Vallisneria spiralis, Monochoria vaginalis, Zannichellia palustre, Sagittaria saggittifolia, Butomus umbellatus, Lemna sp., Najas minor, Nelumbium speciosum, Utricularia flexuosa, and Marsilia sp.*

(7) *Invasion of Eichhornia crassipes in the interior of the United Provinces :* (Indian Science Congress, Patna, 1933).

The intrusion of the water hyacinth (*Eichhornia crassipes*) into the United Provinces is proceeding so rapidly as to constitute a future menace which, if unchecked, may assume proportions comparable to those of Bengal. Districts completely immune from this pest, as recently as 20 years ago, are now replete with it. The invasion has not been confined to the more easterly districts such as Benares and Mirzapur, but has progressed to northern districts such as Basti and Gorakhpur and even to the extreme west as in Dehra Dun and Hardwar.

It has been observed that propagation mainly takes place in two ways. The attractive flowers of this plant are plucked by villagers and plants conveyed from place to place. Birds also carry portions of plants from locality to locality.

(8) *Some observations on the anomalous Distribution and Ecology of Nymphæa tetragona Georgi:* (Indian Science Congress, Patna, 1933).

Out of all the water-lilies found in India, *Nymphæa tetragona* Georgi (syn. *Nymphæa pygmæa* Aiton) is one of the most interesting types from the point of view of its peculiar geographical distribution and its ecological relations. The author has studied this plant for a number of years both from his collections made at Gulmarg in Kashmir and from herbarium material at Kew and Royal Botanic Gardens, Sibpur.

So far as its distribution in India is concerned, *N. tetragona* has been recorded so far from only two localities—(1) Gulmarg in Kashmir and (2) Nongkreem on the Khasia Hills. No one has collected this plant from any other locality in India. It is suggested that accidental transport by migratory birds has probably been the cause of this anomalous distribution.

This paper also embodies observations relating to the phenology and ecological relations of *N. tetragona.*

(9) *The role of Parrotia Jacquemontiana Dene. in the Forest Ecology of Kashmir State:* (Indian Science Congress, Patna, 1933).

Parrotia Jacquemontiana Dene. occurs as an underwood in various kinds of woodlands in Kashmir. It produces rank growth in Deodar, blue pine and silver forests at altitudes between 3,000 ft. and 8,500 ft.

Since it impedes the natural regeneration of such valuable timber trees as *Cedrus Deodara, Pinus excelsa* and others,

drastic methods *i. e.* burning entire underwoods of *Parrotia* have been, more recently, resorted to, in order to eradicate the pest from certain localities in Kashmir.

The author's observations lead him to believe that wholesale burning of forest undergrowth produces profound changes in the physico-chemical properties and microbiological population of the soil, which instead of being beneficial are positively detrimental to the natural regeneration of both Deodar and blue pine. Apart from the fact that it is used as fodder for cattle, fuel for villagers and in making tool-handles, wicker work and rope bridges, its ecological importance in the general economy of Kashmir forests, especially in connection with afforestation schemes, must not be underrated. In fact his observations tend to show that *Parrotia* actually improves the soil and in nature is a definite ecological stage in succession which prepares the way for the migration and ecesis of the Deodar in those localities which are initially unfit for its (Deodar) growth.

S. K. Mukerji, S. C. Verma, and S. N. Asthana.

(10) *On the ecological investigation of twelve different kinds of seedlings belonging to ten families of flowering plants from the Lucknow flora, with a view to find the causes of excessive seedling mortality in nature :* (Proc. Indian Science Congress, Bangalore, pp. 329-330, 1932).

An intensive study of seedlings of a dozen species of wild plants has been carried out for some time past, with a view to find the causes of excessive seedling mortality in nature, their soil requirements and other ecological characteristics. This paper briefly embodies the results so far obtained.

A large number of seedlings of the plants mentioned below were collected from wild localities and studied both in the field and in the laboratory. The plants selected were *Bonnaya bracheata, Vandellia crustacea, Scoparia dulcis, Sida veronici-*

folia, Blumea hieracia var, Hamiltonii, Eugenia jambolana, Phyllanthus Niruri, Rungia parviflora var. pectinata, Amaranthus viridis, Typhonium trilobatum, Commelina bengalensis, and Portulaca quadrifida.

Fresh weight, dry weight, ash content, rooting depth and average height of a number of bunches of a hundred seedlings each collected at random in nature were determined. At the same time, soil samples were taken for analysis from the very localities from where seedlings were collected in order to find out the correlation of the principal soil factors with the growth and mortality of seedlings in nature.

An interesting correlation has been found to exist between the ash content of the seedlings of *Bonnaya bracheata* and *Vandellia crustacea* and the total carbonate content of the soil where they grow. Other factors being alike, the ash content of these seedlings was high (10·9 per cent) where the total carbonate content of the soil was low (·468 per cent) and *vice versa.*

The hydrogen-ion-concentration of the expressed sap of all the twelve kinds of seedlings was examined and it was found that the sap was in majority of cases acidic – *Eugenia jambolana* giving most acidic reaction with pH 4·2. The sap of *Sida veronicifolia* gave an alkaline reaction pH 7·3.

In competition between seedlings of different species, growing densely together, soil factors, *e.g.*, carbonate content, water content, organic content and hydrogen-ion-concentration appear to exercise a decisive influence. Some species prefer high carbonate content while others cannot tolerate an excess of carbonate. Thus, *e.g.*, seedlings of *Bonnaya*, *Vandellia* and *Portulaca* are able to oust those of *Rungia* and *Sida* from soils where carbonate content is high. In this way, dense masses of seedlings die down to the ground before attaining maturity because the balance of edaphic and climatic factors

happen to be against them in the struggle for existence which is very keen at this stage in their life-history.

H. P. Chowdhury.

(1) *A study of the intercellular system of the apple and of the correlation between the size of the intercellular spaces and the transpiratory and respiratory activities of the fruit:* (Proc. Indian Science Congress, Madras, p. 246-247, 1929).

This investigation was carried out to find whether there was any relation between the amount of intercellular space and the amount of transpiration and respiration.

The approximately proportionate amount of intercellular space was calculated from the weight, density of apple, and the densities of expressed juice.

It was found by plotting the specific gravity of 100 grams of apple against the rate of transpiration and the rate of CO_2 production that there is no correlation between the amount of intercellular space and rates of these processes. It appeared that the variation in the intercellular space had no appreciable influence on transpiration or respiratory activity. This is probably due to the prominent part played by the skin in controlling the diffusion of gases and vapours from the apples.

(2) *The effect of the concentration of sap on the rate of respiration:* (Proc. Indian Science Congress, Madras, p. 247, 1929).

Fruits which are subjected to conditions which have a drying effect get their cell sap concentrated. It became necessary to find out whether the concentration of the sap thus brought about tends to have some effect on the respiration of fruits. Processes that bring about the concentration

of the sap rapidly, such as by drying in hot air or by subjecting the fruits to a current of dry air, might have deleterious effect. It was therefore thought fit to bring about the gradual concentration of the sap by playing a current of air possessing different vapour pressures over the sections of tangerines. This was brought about by bubbling CO_2 free air through various concentrations of calcium chloride solutions. The air was ultimately bubbled through NaOH solution and the amount of respiration found.

Drying experiments carried out on tangerine orange sections by exposing to air of different vapour tensions indicate that a fairly long time is taken to reach the equilibrium point.

In a particular experiment which was carried on at a laboratory temperature of 9° to 10° C. the loss of weight of tangerine sections in air passed through 10,30,40 and 60 per cent $CaCl_2$ solutions for a period of 12 days, was 4,14,15 and 22 per cent respectively, showing that apart from individual fluctuations the amount of dehydration has a linear connection with the amount of vapour tension of the air in which the material is exposed.

Respiration experiments show that a fall in the rate of respiration takes place when the orange material is exposed to air of low vapour pressure, the decrease generally manifesting itself after the second day when the material is well on the way to equilibrium point.

The material which is exposed to air passed through 10 or 20 per cent $CaCl_2$ shows an initial rise in respiration as compared with the material which is exposed to higher concentrations of $CaCl_2$ solutions such as 30 or 40 per cent. This fall synchronises with the greater loss in weight.

It seems that the explanation given by Maige and Nicolas for the rise in respiration with the increase in turgidity, *viz.*,

that it may be due to the increase in volume of protoplasm, is a more satisfactory one in many cases.

After considering all the possible factors influencing the rate of respiration with the rise in the concentration of sap, it is pointed out that the fall in the respiration with the rise in the concentration of sap is not due mainly to this factor, but to the decrease in the surface of the protoplasm brought about by the dehydration on account of exposure to air having a lower vapour pressure than that of sap.

(3) *A method of measuring the size of cells in the parenchymatous tissue of apples and a comparison of cell size in apples from different localities:* (Proc. Indian Science Congress, Allahabad, p. 292-293, 1930).

During the course of an investigation on apple it became necessary to find out whether the same variety of apples grown on different soils showed any variation in the size of cells in their parenchymatous tissue. Attempts were made to disintegrate apple tissue in various disintegrating fluids such as dilute ammonium oxalate, potassium oxalate, hydrochloric acid, cytase got from *Botrytis cinerea* and dilute sodium hydroxide, etc. Experiments showed that the best disintegrating fluid in the case of ripe or nearly ripe apples was N/20 NaOH. This disintegrating fluid was therefore used in the case of Worcester Pearmain-apple, grown in different soils. The disintegrated cells were measured under the microscope by means of an eye-piece micrometer, the length and breadth of cells being noted. The product of the length and the breadth gave the surface area which was computed on the supposition that the cells could either be taken as conformable to ellipses, circles, or rectangles. From comparison it was found out that the error introduced in taking the cells as ellipsis or ellipsoid was least, being only 2-4 per cent. whereas when the cells were taken as circles or rectangles, the error can be as much as 6-10 per cent.

The mean surface areas of 100 cells of each sample were also drawn by camera lucida directly on squared paper divided in mm. or traced on squared paper from camera lucida drawings on other paper and their surface area found by counting the number of squares. It was found that this method is quite a rapid one when a large number of samples have to be examined and the error introduced in such cases is less than 5 per cent. Applying this method it was found that some of the soils had marked effect in altering the size of cells of the parenchymatous tissue. This change is propably due to metabolic changes brought about by the kind and amount of ions entering the plants from different soils.

(4) *Preliminary survey of the algal vegetation at Dwarka :* (Proc. Indian Science Congress, Bangalore, p. 294, 1932).

Dwarka is very rich in marine algal vegetation. A large collection of it has been taken away by Börgesen who is at present working on it. He has recently brought out a paper dealing with the Chlorophyceae and Phaeophyceæ from the shores of the Presidency of Bombay and his paper on the Rhodophyceæ has probably by this time come out.

A trip was made in January 1930 with a party of post-graduate students and a collection was made of some of the littoral forms or forms washed ashore. The collection was hurried as the time at our disposal was very short. The following have so far been identified :

PHAEOPHYCEÆ.

Colpomenia stellata.
Sargassum sp.
Eudesme sp.
Ectocarpus Mitchellae.
Hydroclathrus cancellatus.
Padina commersonii.

RHODOPHYCEÆ.

Polysiphonia— several species.	*? Grateloupia sp.*
Champia sp.	*Liagora sp.*
Rhodymenia sp.	*Hypnea musciformis.*
Chrysomenia uvaria.	*? Griffithsia sp.*
Phyllophora sp.	*Lithothamnion sp.*
Chondria sp.	*Gracilaria sp.*
Scinaia sp.	*Laurencia sp.*
Amphiroa sp.	*Asparogopsis sp.*
Halymenia sp.	*Galaxaura sp.*
Gelidium sp.	*Leveillea jungermannioides*

(5) *Myxobacteriaceae. Note on a species of Myxococcus found in Lucknow:* (Proc. Indian Science Congress, Bangalore p. 295, 1932).

Mention is made for the first time of a species of *Myxococcus* found accidentally growing on horse-dung left for the culture of *Pilobolus*. It has a small almost a globate structure of about a mm. in diameter, orange or bright yellow in colour. It does not seem to be any of the species mentioned by Thaxter in his papers.

(6) *Fungus flora of Lucknow:* (Proc. Indian Science Congress, Bangalore, p. 297, 1932).

Attempts are being made to collect the materials of fungi in or near about Lucknow. Most of the forms which have been found have been mentioned by Kanhaiya Lal and Mitter and Tandon in their Fungus flora of Allahabad. A few of the forms found here, and which have not been mentioned by them, are given here:—

1. *Trametes sp.*	5. *Lepiota sp.*
2. *Hexagonia sp.*	6. *Pleurotus sp.*
3. *Fistulina sp.*	7. *Lentinus sp.*
4. *Lenzites*—several species.	8. *Podaxis carcinomalis.*

H. P. Chowdhury and Satyendra Nath Ray.

(7) *Theory of Liesegang phenomena by evaporation from walls :* (Indian Science Congress, Patna, 1933).

Liesegang deposits have been observed by the authors by dipping strips or blocks of tied blotting papers in red ink or inorganic salt solutions.

These phenomena under the conditions can be explained by applying an analogue of the well-known formula of heat conduction :—

$$dq = -KA\left(\frac{dc}{dx}\right) dt$$

Where c = the concentration going across a section.

A periodic variation of c, the concentration, with height can be obtained by assuming the loss of water from the face exposed to the atmosphere to be proportional to the vapour and therefore to the factor $(1\text{-}kc)$.

Closer or more distant rings or layers found in the Liesegang phenomena can be explained on the basis of the results thus obtained. The effect of wetting the block as well as of the humidity of the atmosphere as indicated by the theory has also been qualitatively verified.

S. K. Pande.

(1) *On the Morphology of Notothylas Levieri Schiffn. M. S.:* (Proc. Indian Science Congress, Madras, pp. 237-38, 1929).

Notothylas Levieri is a common Liverwort that grows abundantly in the outer and the Kumaon Himalayas between the heights of 6,000 and 7,000 ft. The earlier accounts of the species deal only with the structure of the thallus and the mature sporophyte.

The species is interesting on account of the absence of the columella from the sporogonium.

The sporophyte of *Notothylas* has been investigated by several authors and conflicting statements have been made as regards the origin of the archesporial tissue and the nature of the columella. It has been stated by some authors that a columella is present in some capsules while it is absent from others in the same species ; and its absence has been variously explained.

The writer has already described in full detail (see No. 3 below) the embryogeny of *N. indica* Kash. in which a well defined columella is always present. It was therefore thought desirable to study the process in *N. Levieri*, a species which lacks a columella. The structure and development of the sex organs so far investigated conforms to the usual type found amongst the Anthocerotales. The early stages of embryogeny are of the usual Anthocerotalean type. No trace of a columella has been detected.

(2) *A study of the liverwort flora of the Kumaun Hills:* (Proc. Indian Science Congress, Nagpur, pp. 264-265, 1931).

This note is based on several excursions carried out in the submontane and the montane zones of the Kumaun Hills mainly with a view to study the Hepatic vegetation of these parts.

As a result of his studies the author is able to record for the first time from the area under investigation the occurrence of some genera and species of Liverworts, *viz.*, ***Ricciocarpus natans*** Corda (at Bhimtal), ***Anthoceros chambensis*** Kashyap (at Bhimtal and Almora), ***Anthoceros Longii*** St. (at Naini Tal), ***Cryptomitrium himalayense*** Kashyap (at Naini Tal).

He has also been able to observe certain interesting features in the following :—

(*a*) *Ricciocarpus natans* Corda. Generally the land form alone of this plant is fertile ; but in his specimens from Bhimtal the author has observed that the aquatic forms bear both the sex organs and sporophytes in different stages of development.

(*b*) *Anthoceros chambensis* Kashyap. Some abnormally long (10 cms.) sporophytes (normal length 2·5 cms.) have been noted in this plant.

(*c*) *Sewardiella tuberifera* Kashyap. In one of the specimens the seta measured about 20 mm. (normal 1·25 mm.) and the capsule was borne well above the perianth. The capsule is usually included within the perianth or slightly exserted.

(3) *On the morphology of Notothylas indica Kash:* (Journal of the Indian Botanical Society XI, pp. 169-177, 1932).

Apart from several interesting features in the structure of the sporophyte of *Notothylas*, an investigation of this plant was also considered desirable, as it is one of the types included for study in the B. Sc. syllabus of the University.

Preliminary results of this investigation were included in the previous research report of the University.

Notothylas indica is a common liverwort growing generally in the plains of the United Provinces in shady habitats during the rainy season ; it has occasionally been found in the Kumaun Himalayas at a height of about 7,000 ft. (*e. g.* Municipal Gardens at Mussoorie). It also occurs at Bombay and Rangoon.

The species is not dioecious as described by Kashyap and Dutt but monoecious and protandrous.

The structure and development of the sexual organs is of the usual type found amongst the Anthocerotales.

Two anomalous archegonia have been described. A detailed account of the embryogeny is given. The foot is derived from the lower two tiers, while the capsule and the seta arise from the uppermost tier. The endothecium produces the columella and the amphithecium forms the archesporium and the wall of the sporogonium.

The columella is well developed and at maturity extends through more than three-fourths of the length of the sporophyte.

Normally the sporogonium has two valves, but in a few cases even three or four may be found. The marginal row of cells, in the normal as well as the accessory valves, possess characteristic brown thickenings.

The valves are hygroscopic and the dehiscence of the sporogonium takes place like a follicle (*i.e.* along one suture only).

(4) *On the morphology of Riccia robusta Kashyap*: (Journal of the Indian Botanical Society, Vol. XII, 2, pp. 110—121, 1933).

Although the life-history of *Riccia* is fairly well known from a study of several foreign species, *R. sanguinea* is the only Indian species of which any detailed account is available. Prof. Kashyap has described several new species from this country including *R. robusta*, but his account is mainly of taxonomic value. A casual examination of *R. robusta* growing here showed some variations from the Lahore plant. In view of this fact and also as *Riccia* is an important type for teaching in the Indian Universities, an investigation of this species was undertaken.

The preliminary results of this study were communicated to the Indian Science Congress, 1927, and included in the previous research report of this University. The plant has now been completely worked out and the results are embodied in this paper.

R. robusta is monoecious. The development of the antheridium as well as that of the archegonium is of the usual type. The mature archegonium has four neck canal cells. Some abnormal archegonia with two egg-like bodies have also been described.

At the time of fertilization the male nucleus is about half the size of the female nucleus. The fertilized oospore divides by an oblique wall. This is followed by another wall at right-angles to it and ultimately a spherical embryo of eight cells is produced (octant stage). The cells of the sporophyte now divide without any regular sequence and give rise to a more or less spherical mass of cells. The wall is cut off from the outermost cells by periclinal divisions and it remains only one cell thick. Ultimately the archesporial cells round off and produce the spore mother cells. Each spore mother cell has a definite nucleolus. In the homotypic division the two spindles may lie parallel or at right-angles to each other. No centrosome or centrosphere has been seen.

The spores are reticulate and the number of reticulations may be 6 or 7.

T. C. N. Singh.

(1) *A preliminary note on the pollination of the coral tree* (*Erythrina indica, Lamk*): (Journal of the Bombay Nat. Hist. Soc. Vol. XXXIII, No. 2, pp. 460-462, 1929).

The coral tree (*Erythrina indica*) is pollinated at Lucknow according to the author, chiefly by Mynas (*Acridotheres tristis tristis*).

(2) *Studies in the morphology of pollen grains. I (a) Boraginaceae:* (Journal of the Indian Botanical Society, Vol. X. No. 1, pp. 38-42, 1931).

The author figures and describes the pollen grains of seven species belonging to six genera of Boraginaceae, and discusses the utility of such studies in classification and phylogeny.

(3) *A note on the response of gram (Cicer arietinum L.) seedlings to electricity:* (New Phytologist, Cambridge, Vol. XXXI, No. 1, pp. 64-65, 1932).

Preliminary experiments on gram seedlings showed a striking modification of the root system under the influence of weak electric currents. The roots of the electrified seedlings showed stunted growth, but an abundance of tertiary rootlets, which were entirely absent in the controls.

(4) *A note on the occurrence of a smut on Selaginella chrysocaulos:* (New Phytologist, Cambridge, Vol. 29, pp. 294-295, 1930).

The stem and leaves of this common Himalayan species of *Selaginella* were found covered with small jet-black spots. On sectioning, these spots proved to be the pustules of a smut fungus closely resembling if not identical with *Entyloma polysporum*. The black colour was due to the resting spores (teleutospores) in which both the uninucleate and the binucleate conditions were seen. Mycelial hyphae were rare at this late stage of the life-history.

T. C. N. Singh and B. N. Sinha.

(5) *Notes on the teratology of certain angiosperms.—Part II:* (Journal of the Indian Botanical Society, Vol. VII, pp. 99-103, pls. 1, 2, 1928).

Descriptions are here given of abnormalities observed in half-a-dozen angiospermous plants.

(i) In *Boerhaavia repanda* Willd., a case of a fasciated leaf (a homologue of two leaves) is described. (ii) *Phlox Drummondii :* notes on the variation in its floral parts are made. (iii) In *Datura Metel* L. hexamery is recorded. (iv) Fasciation of fruits (a homologue of two) is described in *Trichosanthes dioica.* It is interesting to note that each part of the fasciated fruit is tri-carpellary, being a complete homologue of a normal Cucurbitaceous gynaeceum. (v) In *Cosmos bipinnatus* fasciation of capitula is noted. (vi) Very interesting is the case of an abnormal capitulum of *Helianthus annuus* L. in which seven " leaf"-like structures looking like involucral bracts (arising from the central region on the disc), are each borne in the axil of a chaffy bract. They have been regarded as homologous to the habitually nearly abortive sepals which have become leafy, and the corresponding flowers bearing them have aborted.

N. P. Chowdhury.

(*1*) *On the occurrence of superficial abaxially placed sori in Osmunda Claytoniana :* (Journal of the Indian Botanical Society, Vol. XI, No. 2, pp, 137-145, 1932).

The author describes the frequent occurrence of distinct abaxially placed sori in some specimens of *Osmunda Claytoniana* from Kashmir. The sori were found on the flat green pinnæ in the region of transition between the fertile part of the frond and the sterile part above it. There was no apparent malformation, and the passage to the normal regions above and below was perfect. This is by no means the first record of superficially placed sporangia in *Osmunda*, but their occurrence in definite sori has not previously been recorded.

The importance of the phenomenon here described will be evident from the following remarks of Professor Bower : " The two positions, the superficial and the marginal, graduate into one another by many intermediate steps. But the position

held by the sori of a species, genus, or even of still larger groups, is as a rule definite, showing that it is not a readily fluctuating character, but is so far constant in the individual species or genus that it may be depended on for comparative purposes. So marked is the constancy of position of the sorus in genera and species that the few exceptions which occur becomes notable."

From a comparative survey of the sporangia in all the forms, living and extinct, which have been more or less definitely referred to the Osmundaceæ, the author concludes that the superficial abaxially placed sorus represents the primitive condition for this family. The condition here described in *Osmunda Claytoniana* is regarded as being possibly of the nature of a reversion, recalling the condition described by Halle and by Walton in the Jurassic fern *Cladotheca undans*.

(2) *A study of the genus Lycopodium in India*: (Indian Science Congress, Patna, 1933).

This work is chiefly based on some Indian species of *Lycopodium* collected by Professor M. O. P. Iyengar and others and kindly placed at the author's disposal. The following species were identified by Mr. K. P. Biswas and the authorities of Kew Herbarium :--

1. *L. Hamiltonii Spring.*
2. *L. setaceum Hamilt.*
3. *L. serratum Thunb.*
4. *L. Phlegmaria L.*
5. *L. Phyllanthum Hk. et. Arn.*
6. *L. Wightianum Wall.*
7. *L. clavatum L.*
8. *L. cernuum L.*

The genus is studied mainly from the point of view of its distribution, anatomy, modes of vegetative propagation, and epidermal structure. The stele in the first five species is essentially radial with considerable modifications in *L. Phlegmaria* and *L. phyllanthum*. In *L. Wightianum* it is of the so-called

'parallel banded' type. The anatomy of *L. Hamiltonii*, *L. setaceum*, *L. phyllanthum*, and *L. Wightianum* is now, as far as the author knows, being described for the first time. Intracortial roots have so far been observed by the author in *L. Hamiltonii*, *L. setaceum*, *L. phyllanthum*, *L. serratum*, and *L. Phlegmaria* only; in the three first named species they are now recorded for the first time. In one of the roots of *L. Hamiltonii* a ring-shaped xylem with an island of phloem in the centre has been observed. In *L. Phlegmaria* and *L. phyllathum* large leafy bulbous buds were seen attached near the base of the main stem of the plant. These bulbs seem to be easily separated from the parent plant and are evidently organs of vegetative reproduction. Root tubercles as described by Treub (Ann. of Bot. I, 122) were found in *L. cernuum*.

An attempt has also been made to test the systematic value of epidermal characters. The epidermal characters of all the above-mentioned species together with many more from other localities have been investigated. The details such as the orientation and size of the stomata, the sinuosity of the walls, and size of the upper and lower epidermal cells, the structure of the guard cells, the presence or absence of a vestibule and the presence or absence of stomata on the upper epidermis, seem to be of diagnostic value. Further work in this line is in progress.

K. M. Gupta.

On the structure of a new species of Indian mosses, Physcomitrellopsis indica Dixon, from Benares: (Indian Science Congress, Patna, 1933).

The material was collected and fixed in chrom-acetic acid by Professor B. Sahni at Benares in 1919 and was given to the author for description.

The plant grows in tufts of green on damp ground. The perichætial leaves are large and completely surround the sex

organs and sporogonium. The plant is monoecious and bears on one and the same head antheridia and archegonia intermixed with two kinds of paraphyses, one club-shaped and the other capitate.

The sporogonium with its characteristic mitriform, deeply lobed calyptra is deeply immersed in the tip of the stem which closely envelopes it. There is a distinct line of dehiscence, composed of smaller cells with lower walls thickened, along which the sporogonium wall ruptures. The upper part of the capsule is thrown off as an operculum but there is no distinct annulus.

This is the first record of the genus *Physcomitrellopsis* from India; the only other species known at present is *P. africana*, from Africa, which is closely allied to it. The occurrence of two closely related species of the same genus in two countries so widely separated by the ocean as India and Africa, is a fact of some plant geographical interest.

DEPARTMENT OF ZOOLOGY.

K. N. Bahl.

The Head of the Department continues to be the editor of the series of monographs on Indian Animal Types and has edited three monographs during the quinquennium :—

(1) *Scoliodon, the shark of the Indian Seas :* (Indian Zoological Memoirs). (No. 2 by E. M. Thillayampalam., Lucknow, 1928).

(2) *Ostrea cuculiata, the Bombay Oyster* : (Indian Zoological Memoirs). (No. 3 by P. R. Awati and H. S. Rai, Lucknow, 1930).

(3) *Pila, the apple-snail :* (Indian Zoological Memoirs). (No. 4 by Baini Prashad, Lucknow, 1931).

The following papers have been published :—

(1) *On the Reproductive Processes and Development of Pila globosa, Swainson:* (Memoirs of the Indian Museum, Calcutta, August, 1928).

After a prolonged period of aestivation underground during the dry months, these snails come to the surface at the onset of the rains and at once pair in water on the ground at the edge of a pool. Pairing may last three hours, during which time the copulating animals may be handled and the principal relations of the male and female ducts ascertained. It was found that by electrocution, one is able suddenly to kill a couple of pairs, and by subsequent dissection to make out the precise details of the copulation. The vas deferens of the male terminates in a papilla lying in the mantle cavity close to the rectum. The penis-sheath and penis are outgrowths of the mantle and are independent of the male opening. Transference of the sperms from the vas deferens to the penis after the latter has been inserted into the mantle-cavity of the female is effected by the genital papilla at the end of the vas deferens being directed into a depression at the proximal end of the penis. The sperms then pass along the penis into the aperture of the vagina of the female. Deposition of eggs takes place a day or two later in some sheltered hollow in the ground. Each egg, after passing out of the vaginal opening, travels down an oblique tube formed by two temporary folds on the right side of the foot and is delivered into a dome-shaped cavity under the foot formed by the arching of the creeping sole. Each egg has a sticky covering ; so the eggs, from 200 or 300 to 800 in number, adhere to form a mass. When egg-laying is completed the snail leaves the egg-mass; there is no incubation of the eggs.

(2) *On the Physiological significance of the enteronephric type of nephridial system found in Indian earthworms:* (Indian Science Congress, Patna, 1933).

During the years 1919-1926, the author described the 'enteronephric' type of nephridial system in earthworms belonging to the genera—*Pheretima*, *Lampito*, and *Woodwardia*. In all these genera, the nephridia discharge their excretion into the intestine instead of on to the surface of the body. It was further suggested that the basis of classification of nephridia should be the place of their opening rather than their size ; Stephenson in his recent monograph on the Oligochaeta has accepted this suggestion and classified the nephridia into 'exonephric' and ' entero-nephric' types.

The question of the physiological significance of these 'entero-nephric' nephridia still remains open although it was suggested in 1919 that the enteronephric system was possibly an adaptation for the conservation of moisture in a dry climate. In the present paper, the author has compared the habits of *Pheretima* with those of *Eutyphoeus*, the former possessing enteronephria and the latter exonephridia. He has, next, compared the castings of these two worms in respect of their shape and consistency, which go to prove that his suggestion is correct. Finally, he has given data with regard to the percentages of moisture present in the castings of these two kinds of worms. In all the five experiments made, the percentage of moisture was higher in the castings of *Eutyphoeus* than in those of *Pheretima* proving conclusively that the gut of *Pheretima* absorbs the water from the excretory fluid and conserves it for the needs of the worm.

K. N. Bahl and M. B. Lal.

(3) *Preliminary experiments and observations on the so-called "alimentary glands" of the earthworm Eutyphoeus:* (Proc. Indian Science Congress, 1930).

Eutyphoeus is a surface-feeding earthworm unlike *Pheretima* which is a burrower. The castings of the two worms are very

different. Darwin was apparently misinformed about these castings, his diagram of the castings of *Perichaeta* really represents the castings of *Eutyphoeus*.

Beddard was the first person to record the presence of "alimentary glands" in *Eutyphoeus* which he regarded as being of the nature of "calciferous glands". The following new observations on these glands may be recorded:—

(i) that they are situated not on the oesophagus but very much further back—a little behind the middle of the body.

(ii) that they occur in connection with the typhlosole, only on the dorsal side of the body.

(iii) that they occupy the last five segments of the typhlosolar region.

(iv) that they open into the gut by several small or large openings all along their length.

(v) that they have a special blood-supply.

Two experiments were made to determine if these glands had a digestive (peptic) function. In (1) glands were taken out of 153 worms (weight of glands = 2·918 gms.) and their extracts were kept at different temperatures for 24 hours with a control tube which was boiled. Titration with formol and soda revealed the presence of amino-acids. The best results were obtained at 30° C. In (2) glands (80 worms with weight of glands = .9 gms) were similarly kept at 30° C with control for 36 hours with the result that a much larger quantity of amino-acids was formed.

Dr. G. S. Thapar.

(1) *A Note on the Excretory system of Discocotyle sagittatum Leuckart, 1842:* (Proc. Indian Science Congress, 1929, Madras).

Little work has been done on the excretory system of Monogenea. In the present communication the author describes the excretory system of *Discocotyle sagittatum* which shows a very closed network of tubes terminating internally in flame cells. The system in the present form is peculiar as it throws light on the origin of the Excretory system in Dignea.

(2) *On Farzandia, a new genus of Acanthocephalid worms from the intestine of Ophiocephalus marulius:* (Annals and Magazine of Natural History, Ser. 10, Vol. VI, p. 76, July, 1930).

The writer (1927) described a new genus Acanthogyrus and proposed a new classification for Acanthocephala, based on a natural system. Recently, the writer received from one of his pupils a very large number of Acanthocephala from the intestine of an Ophiocephalus. These, on closer examination, appear to belong to a new genus of the family Acanthogyridæ Thapar, 1927. The chief peculiarities of this form are :—

(*i*) The proboscis is spherical and is armed with four alternate rows of eight hooks each, (*ii*) There is a distinct neck, (*iii*) The body is armed with regular rows of spines, These spines are, for the first 8 to 10 rows, more closely arranged than over the rest of the body, (*iv*) The genital organs have prostate glands which present a syncytial arrangement, with a number of scattered nuclei. (*v*) The ductus ejaculatorius is not Y-shaped, as is in the genus Acanthogyrus.

The name **Farzandia** ophiocephali n. g. n.sp. is given to this form.

A detailed account of the anatomy of the worm is given, and is followed by a discussion on the systematic position of the genus in question. It further supports the view already put forward by the author in his previous (1927) communication concerning the classification of the Acanthocephala.

(3) *Sur un nouveau Trematode d'un poisson de l'inde, Gomtia piscicola n. g., n. sp:* (Annales de Parasitologie Humaine et comparée, Tome VIII—Nos. 3-4—Juillet, 1930).

A large number of specimens were obtained from the intestine of a Siluroid fish at Lucknow, and they belong to the family Opisthorchidæ. The form described here presents certain characteristic features which indicate that it is new to science. The chief peculiarities are :—

(i) The body is covered over with spines, (*ii*) There is a well developed elongated pre-pharynx, as long as the œsophagus, (*iii*) The intestinal crura reach the posterior end of the body, (*iv*) The excretory vesicle is an elongated straight tube, and does not show the S-shaped curve so characteristic of the genus Opisthorchis, (*v*) The ovary is in front of the two testes, and all three are situated one behind the other in a linear series, (*vi*) The uterus is between the ovary and the acetabulum, (*vii*) The yolk glands are in the middle third of the body, extending posteriorly in front of the testes, (*viii*) There is no cirrus and no cirrus sac.

The new trematode is given the name of *Gomtia piscicola.*

(4) *On a new Trematode from the intestine of yellow bat, Nycticejus kühli :* (Proc. Indian Science Congress, Nagpur, 1931).

Only a single specimen was obtained from the intestine of the common Indian bat, *Nycticejus kuhli* and this on closer examination appears new to science.

The form conforms in general characters, to the members of the family Dicrocœlidæ Odhner, 1911, but differs from all of them in the following features :—

(*i*) The extra-coecal position of the testes, (*ii*) Intercoecal and post-testicular ovary, (*iii*) Absence of an oesophagus or a pre-pharynx, and (*iv*) Presence of a descending and an ascending limb of the uterus.

The Excretory system is fully worked out and it has the characteristic formula represented thus: [2 (2 + 2 + 2) + (2 + 2 + 2)]. The paper describes in details the anatomy of the worm.

It differs from *Mesodendrium attie Bhalerao*, 1926, in having its intestinal coeca extending to the posterior end of the body and also in having distinctly branched follicles of the vitelline glands.

The systematic position of the form is also discussed.

(5) *A survey of helminthic infections of man in Lucknow :* (Proc. Indian Science Congress, Nagpur, 1931).

A good deal of work has been done on a systematic survey of the helminthic infections in other countries, but so far no definite record of this nature is available here. With a view to collect the necessary information about the helminthic infections at Lucknow, the writer, with the help of a local medical practitioner started the work about two years ago and

as a result of his investigation the following data were prepared. In all about 100 cases were examined.

The usual clinical methods of examinations of the blood, sputum, and the faeces were followed.

No case of trematode infection was found.

Amongst the cestodes, only two genera were available. *Taenia saginata* proglottids were collected on several occasions. On two occasions, proglottids of the *Hymenolepis* were also collected and one case passed out, after treatment, small tapeworm, *Hymenolepis nana*. No other cestode has so far been found.

Ascaris lumbricoides is perhaps the commonest nematode infection at Lucknow, and several cases are reported. The source of infection seems to be the filthy environments of the dwelling places. It is more widespread amongst the poor classes.

Enterobius vermicularis is a very common infection of children and the worms were recovered on several occasions. An interesting case is reported where all the members of a family, in a neat locality, showed the symptoms of the infection. This was later on verified by collecting the parasites.

Stray cases of *Ancylostoma* infections are also reported, where an examination of the stools showed the presence of eggs. No adult was, however, recovered.

In a few cases, Microfilariæ were seen in the blood. Cases of multiple infections were not uncommon.

Sources of helminthic infections are also dealt with. One of them appears to be the "Sewage and Sullage Farms". A scheme was submitted to the Director, Provincial Hygiene Institute, Lucknow, with a view to start an enquiry into the working of these farms and thereby to determine their role in the spread of the helminthic infections.

(6) *The Alimentary glands of the Earthworms of the Genus Eutyphœus.* (Current Science, Vol. I., No. 5, November, 1932).

The glands associated with the alimentary canal of Eutyphœus fall under three categories according to their position along the alimentary canal: (a) Pharyngeal glands, (b) Calciferous glands in the region of the oesophagus, and (c) the Alimentary glands in the region of the intestine. The glands of the first two groups have been thoroughly investigated on different occasions by several workers, the latest work being that of Stephenson, but the alimentary glands have not received any attention so far. I, therefore, determined to investigate the morphology of these structures in the two species of Eutyphœus that occur in Lucknow and read a preliminary note before the Zoology Section of the Indian Science Congress in 1923. The chief features of these glands are as follows:—

The glands are paired structures, fairly conspicuous in the ordinary dissection of the animal, extending over the intestine on either side of the dorsal vessel in four to five consecutive segments, beginning with the segment 80 backwards. They are separated from each other by the intervening septa and are bilobed. These glands are in communication with the alimentary canal by independent openings that are lined by ciliated epithelum.

The histology of the glands shows that each is composed of a large number of lamellæ projecting into the cavity of the glands, and these either unite with the adjacent lamellæ or split to reunite. (Figs. 2 and 4). Some of the lamellæ are larger than the rest and all of them contain blood spaces, some of which swell up at their free ends owing to the engorgement of blood.

The glands have peritoneal cells covering the muscular layer, which latter is, however, deficient in the lamellæ. The inner lining of the gland consists of cubical cells full of granular material which also surround the lamellæ.

The blood supply of the glands is from the dorsal vessel and also from the supraneural vessel. The branches of both the vessels ramify in the substance of the gland and form a complete anastomosis, thereby indicating a kind of portal system. Further investigations may show that the glands are of the nature of a liver that pours a digestive secretion into the gut.

(7) *A new blood fluke from an Indian tortoise, Trionyx gangeticus :* (Journal of Helminthology).

Hermaphroditic trematodes from the blood vessels of the turtles are included under the family Spirorchidæ and are represented by several genera. A good deal of work has been done on this group in the West, but so for as I am aware nothing is known about it from India. In the present communication a new genus of blood flukes is described from *Trionyx gangeticus.*

The genus is characterised by the following features :—

(*i*) Absence of the cuticular spines over the body; (*ii*) Presence of protrusible suckers ; (*iii*) Absence of a pharynx; (*iv*) Presence of a bicornuate excretory bladder; (*v* Presence of ovary between the two testes, and all three are lobed structures ; (*vi*) Dorsal and sinistral position of the genital pore; (*vii*) Position of both seminal vesicle and cirrus anterior to the testes; and (*viii*) Presence of extensive vitellaria.

The paper concludes with a discussion on the systematic position of the genus and it seems to connect together the two

genera—*Hapalotrema* and *Hapalorhynchus* of the sub-family Hapalotreminæ.

The name suggested for this new trematode is *Tremarhynchus indicus*, n. g., n. sp.

(8) *On a new trematode of the genus Astiotrema Looss, 1900, from the instestine of a tortoise, Chitra Indica :* (Indian Science Congress, Patna, 1933).

The genus Astiotrema was erected by Looss in 1900 for the reception of two species, *Distomum reniferum* and *Astia impleta*. Subsequently several other species have been added to the genus. The present paper adds yet another species, *Astiotrema indica* n. sp., to the genus in question.

The specimens were obtained from the intestine of *Chitra Indica* from the river Gomti and present the following characters: —

(*i*) spherical ovary in front of the testes ; (*ii*) The testes are lobed 9-10 lobes in each : (*iii*) *Receptaculum seminis* is large, semilunar in shape, transversely disposed across the body ; (*iv*) The cirrus is very characteristic and forms a definite coil in its course.

A detailed account of the anatomy of the trematode is given. The paper concludes with a discussion on the status of the sub-family *Astiotreminæ Baer*, 1924, and in the light of the recent researches, gives an amended definition of this sub-family.

G. S. Thapar and Farzand Ali.

(9) *On the Trematodes of the digestive tract of Tropidonotus piscator from Lucknow.* (Journal of Helminthology, Vol. VII, No. 4, December, 1929, pp. 247-252).

Nicoll (1914) found a single specimen of *Ommatobrephus singularis* from the intestine of *Uromastix acanthinurus*. The

form is peculiar in the position of the genital glands and the precocious development of miracidia while the eggs are still within the uterus. Recently, we have found in Lucknow two distinct forms of Trematodes from the intestine of *Tropidonotus piscator;* one of these is *Acanthochasmus burminus* Bhalerao (1926) and the other is new to science. This form resembles *Ommatobrephus singularis* in general characters but differs from it in the following features:—

(*i*) The crura of the intestine extend backwards to the posterior end; (*ii*) Testes are lobed and widely apart; and (*iii*) Vitellaria extend back from the posterior sucker to the middle of the testes.

The present form is given the name, *Ommatobrephus folium*

G. S. Thapar and M. B. Lal.

(10) *On the morphology of Discocotyle sagittatum:* (Indian Science Congress, Patna, 1933).

In the course of his investigations on the helminth parasites of fishes that died in the aquarium of the London Zoological Society, the senior author found a very heavy infection in the gills of salmon trouts by these parasites. The excretory system was there examined in fresh specimens and the other details in the anatomy are now studied by both of us from a series of prepared slides.

The genus *Discocotyle* has been studied by several earlier workers but the following interesting features are now being recorded:—

(*i*) the division of the body into three regions, the large middle region being the sexual region of the animal; (*ii*) the branched diverticula of the intestine; (*iii*) the peculiarities and details in the excretory system appearing to connect Monogena

and Digenea together; and (*iv*) the peculiar process at one end of the egg.

A detailed account of the anatomy, particularly of the excretory and reproductive systems, is given in the paper.

G. S. Thapar and J. Dayal.

(11) *On the morphology of a new Trematode from Golden orfe:* (Indian Science Congress, Patna, 1933).

A large number of trematodes were collected from the intestine of Golden orfe and they present the following distinguishing characters:—

(*i*) presence of genital sucker anterior to the acetabulum; (*ii*) diagonal and lobed testes; (*iii*) the lobed ovary in between the two testes; and (*iv*) coiled uterus lying between the acetabulum and the posterior testis.

A detailed account of the anatomy of the animal is given. The paper concludes with discussion on the systematic position of the animal. It appears to be closely allied to the genus *Sphaerostoma*, but differs from it in several important features which necessitate the creation of a new genus for the present form.

M. L. Bhatia.

(1) *Hermaphrodite organs of the Indian leech Hirudinaria granulosa:* (Proc. Indian Science Congress, 1928).

Male organs:—

There are eleven pairs of testes segmentally arranged from the 13th to the 23rd somites connected with the vasa deferentia of the corresponding side. In front of the first pair of the

testes, *i. e.* in segment 12, the vasa deferentia continue their normal course, but in segment 11 they increase in width and form complex coils, the epididymis. From the inner side of each a short ejaculatory duct opens at the base of the penis, which is an eversible organ lying in segment 11.

Female organs :—

The Female organs lie in the 12th and 13th segments. The ovaries are a pair of minute filamentous bodies enclosed in small sacs lying close to the mid-ventral line. They are continued into short oviducts, the left oviduct passing under the nerve cord. The vagina is an elongated sac-like structure, expanded at the base but narrow at its distal end which opens to the exterior between the 4th and 5th annuli of segment 12.

The variations from the condition in Hirudo medicinalis are detailed in the paper.

(2) *Cocoon formation of Hirudinaria granulosa :* (Proc. Indian Science Congress, 1928).

The area of the body between X to XIII somites (fifteen annuli) is concerned in the formation of the cocoon. This portion of the animal may be called the clitellar region, though a permanent clitellum, as is found in earthworms, is never present. During the cocoon formation a white frothy girdle appears round these annuli, no doubt formed from the secretion of the epidermal glands in that region. The ova are ejected through the female aperture and the animal slowly withdraws its head through the froth by the rhythmic contractions of the body. When the head is completely withdrawn, the openings at the anterior and posterior ends of the cocoon soon close up. The process of cocoon laying lasts for about five to six hours. In about 24 hours the froth hardens, becomes brown and cocoon assumes an oval shape, measuring 15 to 30 mm. in length. The wall of the cocoon consists of an

inner membranous layer and an outer spongy layer enclosing the air bubbles, which make the cocoon float in water.

(3) *On the arterial system of the lizard Uromastix hardwickii Gray :* (Journal of Morphology and Physiology, Vol. 48, No. 1, September, 1929).

The arterial system of Uromastix hardwickii retains many primitive features and shows great resemblance and relationship to that of *Sphenodon.* The heart is typically reptilian. Two systemics and a pulmonary arch arise from the ventricle. The conus arteriosus is absent. The carotids arise together from the right systemic by means of a small common carotis primaria. A very well-developed ductus caroticus connects each carotid with the systemic arch of its side. The ductus arteriosus (ductus Botalli) is absent.

The dorsal aorta is formed by the union of both the systemic arches. The left systemic joins entire, while the right one, which is termed systemico-carotid trunk, gives off the carotids, the vertebral, a single subclavian, and two pairs of parietal arteries, before the union. Anterior epigastric arteries are altogether absent. The dorsal aorta gives off fifteen pairs of parietal arteries which are segmentally arranged. All the main branches supplying the alimentary canal and other visceral organs arise independently of one another, there being no such combination as is found in *Varanus.*

(4) *The venous system of a Lizard Uromastix hardwickii (Gray) :* (Zoologischer Anzeiger Bd. 85, Heft 1/2, 1929 Leipzig).

The following are the points dealt with in this paper :—

(*i*) A detailed account of both the Hepatic and Renal Portal systems which are very well developed in the Uromastix and (*ii*) A primitive feature of the anterior abdominal vein.

(5) *Effects of temperature and moisture on cocoon laying in the common Indian leech, Hirudinaria granulosa:* (Proc. Indian Science Congress, Madras, 1929).

About 30 adult leeches were kept in a glass jar in the beginning of April and allowed to copulate. Those which had copulated were separated, each one was kept under observation in an earthen pot with some moist lumps of black clay. Each pot was numbered and placed in a bowl of water in order to keep the clay inside the vessel wet. A piece of muslin was tied round the mouth of the pot, and water in the bowl was renewed every day.

Cocoon laying in Lucknow commences by the middle of April and lasts for about a month and a half.

Renewal of water in the bowl and daily temperature were noted. It has been observed that cocoon laying can be induced by adverse conditions *i. e.*, by tendency to dryness and rise of temperature.

A detailed account and graphs showing the rise of temperature and reduction of water along with formation of cocoon is given in the paper.

(6) *On a new Rhynchobdellid leech, Glossiphonia cruciata n. sp. from the Trout hatchery, Achha Bal, Kashmir:* (Annales de Parasitologie, Tome VIII, Nos. 3-4, 1930).

Body elliptical or claviform, dull green in colour, length 11 mm. Rings 70. Three pairs of eyes lie in rings 3rd, 4th and 5th. Crop with 6 pairs of unbranched diverticula, and intestine with four pairs. Six pairs of testes. *The ovaries form a cross in somite XIII.* The male orifice lies in the groove between XIth and XIIth somites and female orifice is 2 annuli behind it.

(7) *On the Anatomical details of Placobdella emydae Harding. A leech parasitic on Indian Turtles:* (Zoologischer Anzeiger, Vol. 91. 9/12, 1930).

The paper includes the anatomical details of the Leech *Placobdella emydae* Harding. The body consists of 71 annuli which are grouped into 27 somites. These are further arranged into the cephalic, pregenital, genital, middle and caudal regions. A pair of eyes is ususally situated in the 3rd ring. The male and female genital apertures are situated in the furrows between annuli 26, 27, 28 and 29 annuli respectively. There are 14 pairs of nephridia.

Proboscis is well developed. The crop has 7 pairs of diverticula. Six pairs of testes lie segmentally in somites 13th to 18th. The epididymis is large, and it is thrown into complex coils and loops in segments 10 to 13. A pair of ovaries is in the 13th segment, which hang freely backwards up to the 14th segment. There seems to be a protandrous tendency, which appears to be a contrivance to ensure cross fertilization. The coelomic or lacunar system is reduced to the condition of narrow longitudinal tube. The blood-vascular system consists of dorsal and ventral blood vessels. The lateral sinuses are also present.

(8) *On a new Rhynchobdellid leech from the Trout hatchery, Achha Bal, Kashmir:* (Proc. Indian Science Congress, Nagpur, 1931).

The body is much flattened and commonly measures 10 mm. in length, inclusive of the suckers, by 3 mm. across the middle. The head is seen separated from the trunk by a slight neck-like narrowing.

On the dorsal side 72 rings are counted in front of the posterior sucker. They are grouped into twenty-seven somites of which I, II, XXVII are uniannulate, somites III, IV, XXVI

biannulate; twenty-one somites V to XXV are complete with three rings.

The four eyes are disposed in two rows. The first and smaller pair lie in ring 2. The second and larger pair occur in ring 4. Both the pairs are directed forwards.

The anterior sucker is cup shaped, about half as broad as the posterior sucker. The mouth is situated at about the middle of the anterior sucker, leading into a short cylindrical pharynx which extends back to somite 10th. Numerous ducts of the salivary glands open in it. Posteriorly the pharynx, is continuous with the crop which extends over seven somites XIV to XX and gives off 7 pairs of lateral pouches which come off metamerically in these somites. In somite XX the crop gives rise dorsally to intestine which bears 4 pair of lateral pouches, a pair in each of somites XX to XXIII. The rectum extends through 3 somites and opens dorsally at the anus just in the middle of somite XXII. There exist six pairs of ovoid testes, situated intermetamerically on either side of the crop in somites 14—15, 15—16, 16—17, 17—18, 18—19, 19—20. Each testis gives short vasa efferens communicating with vas deferens, which pursues a forwardly directed tortuous course, and in somites XIII, XII, XI dilates into a thick walled glandular canal. In the region of male genital aperture the canal nears the median line and finally unites with its fellow of the opposite side and opens in the groove between somites XI, XII.

The ovaries are represented by a pair of sacs lying in somites XIV to XVIII. They represent unique shape in this species, inasmuch as they are metamerically lobed. Two oviducts run forward in somite XIII. Not far behind the female genital aperture they unite into a short common duct which makes its way to the exterior. The female genital orifice is situated

two rings behind the male, between annuli 29, 30 being the 2nd and 3rd rings of somite XII.

(9) *The Prostomial glands of Hirudinaria granulosa and their function:* (Proc. Indian Science Congress, Nagpur, 1931).

In Hirudinaria there is a set of deep lying glands situated in the prostomium and the region around the mouth. They form a distinct group and send their ducts forwards to open all round the edge of the buccal cavity. They are perfectly distinct from the salivary glands, there being a considerable space between the most posterior of these and the most anterior of the salivary glands. These glands are very prominent during the breeding season.

Prof. Bourne mentions, " I am unable to determine absolutely their function, which must remain for the present as a matter of further investigation."

The writer's observations on the cocoon laying habits of *Hirudinaria* indicate that secretions from the prostomial glands form the plugs which close the anterior and posterior ends of the cocoon.

These plugs undergo considerable contraction and become detached, in the form of lids. Young ones hatch out in about a fortnight through the openings formed in the place of the plugs.

(10) *Some abnormalities in the Indian leech, Hirudinaria granulosa:* (Proc. Indian Science Congress, 1932).

(i) Eyes.—The normal number of eyes in this species is 5 pairs. They are metamerically disposed in segments 2, 3, 4, 5 and 6, a pair being present in each segment.

Eyes both in number and arrangement are of great diagnostic value. The full number of eyes may not always be present. Specimens have been collected at different times with one, two or even three eyes less.

(ii) Posterior Sucker.—Specimens were collected which were devoid of the posterior sucker. It is evidently accidental. These were kept under observation. The anterior sucker is more strongly developed and very well compensates for the absence of the posterior sucker. The anal aperture in such specimens is placed at the posterior extremity.

(iii) Crop.—The crop which extends over somites IX to XIX consists of a metameric series of axial chambers separated by intersegmental constrictions. Each chamber bears a single pair of caeca. These caeca begin in segment X The pregenital pairs are usually smaller and irregular. The post-genital caeca are fully developed and reach the segment next to it.

The posterior ends of caeca in the posterior genital region get fused with the axial chamber, thus forming a more spacious system for storing blood.

M. L. Bhatia and J. Dayal.

(11) *Notes on the blood vascular system of Hemidactylus flaviviridis Ruppel (the wall lizard).* (Proc. Indian Science Congress, 1929).

Three arterial trunks arise from the ventricle, and become right and left Systemic and Pulmonary. The systemic arches cross each other at their origin, so that the one arising from the right becomes the left and the other one from the left becomes right.

The innominate arising from the the right systemic is very small and soon divides into right and left carotids, which run outwards and bifurcate into internal and external caro-

tids. At the place of bifurcation is seen a very prominent carotid gland. The ductus caroticus which is a connection joining the carotids and systemic arches also takes its origin at the place where carotid gland is situated.

The presence of laryngeal artery (laryngeo tracheal O'Donoghue) arising from the Pulmonary arch is an interesting feature. It passes up along the sides of the trachea, to which it sends small twigs finally breaking up in the larynx.

All the main branches supplying the different parts of the alimentary canal arise separately from the dorsal Aorta. On the whole it shows great resemblance to *Sphenodon*, which is considered a primitive type.

The venous system shows big sinuses in the anterior region.

Both the hepatic and renal portal systems are well deveoped. A detailed account of the venous and the arterial systems is also given.

J. Dayal.

(1) *Notes on the anatomy of Pentaceros (a star-fish from the Indian Ocean):* (Proc. Indian Science Congress, 1929).

The English text-books describe the starfish *Asterias* and until lately the practice was to obtain specimens from abroad and give them to the students for dissection. Now we get a plentiful supply of *Pentaceros* from Ennur which is dissected nowadays by the students of Zoology. The present paper gives an account of the anatomy of *Pentaceros*.

Pentaceros belongs to Phanerozonia (Family Pentacerotidae) It possesses a relatively large disc and short arms, which taper gradually towards their extremities. The oral surface is flat and covered over with a number of minute rounded granules or tubercles, which on the adambulacral ossicles assume the form of short, blunt spines. Well-developed marginal plates

are present, and the adambulacral ossicles take a prominent place in the circumoral ring of ossicles.

Abactinal surface is strongly convex and the skeleton is reticulate and regular, with more or less definite intermediate triangular pore areas. The ossicles on the aboral side are covered with prominent mammilated tubercles and the rays are carinated.

The pedicellariae of *Pentaceros* are all sessile and are of forficiform, valvate and alveolate types.

Prominent interradial septa are also present.

The alimentary canal possesses five radial pouches of the stomach, ten radial hepatic caeca, and five bifid rectal caeca placed interradially on each side of the interradial septum. Each rectal caecum is beset with a large number of pouches. The anus is in the centre of the disc on the aboral side.

The water vascular system in its general features resembles that of *Asterias* but differs from it in the possession of four polian vesicles placed interradially, and only one row of tube feet on each side of the ambulacral groove, but the ampullae are in two rows, an upper and a lower, and each tube-foot has two ampullae connected with it, one of the upper row and one of the lower row.

A detailed account of the external morphology, skeleton and the various organs is given in the paper.

(2) *On the Urino-genital system of the lizard, Uromastix hardwickii (Gray):* (Proc. Indian Science Congress, 1931).

Very little is known about the urino-genital system of Lizards. The writer, in his studies on *Uromastix*, has worked out completely the morphology of these organs and their relationship with each other.

The main features requiring attention are :—

(*i*) The presence of a three-chambered cloaca, in both male and female, a feature in which it resembles birds, (*ii*) Complete absence of a penis, and (*iii*) Persistence of the Wolffian and the Mullerian ducts in both the sexes, but Mullerian is non-functional in the male while the Wolffian is non-functional in the female.

A detailed account of the system is given for both, male and female.

(3) *On the Chondrocranium of the Squirrel, Sciurus palmarum* · (Proc. Indian Science Congress, 1931).

With a view to study the development of the squirrel the writer collected a large number of the early embryonic stages from the gravid female. The present communication confines itself to the structure of the chondrocranium alone.

The account agrees in general outlines with De Beer's description of the Chondrocranium of rabbit. The following features are particularly studied in the embryo with head 14 mm. and body 29 mm. long.

The brain case and sense capsules are cartilaginous. a greater portion of the roof and the side walls membranous and the floor consists of parachordals and trabeculae as usual. The hypophysial fossa is well marked.

The auditory capsule consists of a cochlear and canalicular portions. It is attached to the parachordals by basi-cochlear commissure. The fissura metotica is continuous and well-marked. Ala temporalis and Ala orbitalis are present in the usual position. The nasal septum and paranasal cartilages bear the same relationship with one another, as in rabbits. The relation of various cartilages with one another is fully discussed.

Comparison of the chondrocranium of the form with the corresponding stage in other allied mammals is also discussed.

(4) *On the urinogenital organs of the common Indian Lizard—Calotes versicolor:* (Indian Science Congress, Patna, 1933).

Very little is known about the urinogenital organs of the common Indian lizards. The kidneys lie at the posterior end of the abdominal cavity and the ureters open into a dorsal pouch of cloaca (Urodaeum). The testes are paired organs lying far forwards in the abdominal cavity by the side of the vertebral column. The vasa-deferentia open separately into the urinary chamber. Copulatory organs are present in the males. The ovaries also lie in the middle of the abdominal cavity. The oviducts open anteriorily in the abdominal cavity and posteriorly into the cloaca.

A detailed account of the urino-genital organs is given. The paper concludes with a comparison of the urinogenital organs with those of *Hemidactylus* and *Uromastix.*

M. B. Lal.

(1) *A short review of the Myriapod collection in the Indian Museum, Calcutta:* (Indian Science Congress, Patna, 1933).

The present paper is the outcome of the author's short stay in Calcutta during the summer of 1930 when he had the opportunity of examining the Myriapod collection in the Indian Museum.

The collection is very useful though by no means rich, as only the coastal regions and some hilly places have been explored; while very few collections have been made from the interior of the country.

For the purpose of showing clearly the extent of exploration for the collection of Myriapods, the author has given about a

dozen outline maps of India, Burma, and Ceylon, and located the places from which collections have been made. A glance at the maps gives an idea of the immense work lying before the zoologists for the study of this group as no collections have been made from vast stretches of the country.

The author has also collected and located some forms of Diplopoda (millipedes) which were not in the museum collection. A detailed list of the genera and species, together with their places of collection, is also given.

(2) *Preliminary notes on the copulation, fertilisation, and egg-laying of the millipede, Thyropygus malayus:* (Indian Science Congress, Patna, 1933).

Bhatia and Choudhary (1927) described copulation in this millipede, though under a wrong name of *Spirostreptus* Brandt., but their observations seem to be inaccurate. The millipedes have been identified as *Thyropygus malayus* and complete and detailed observations are recorded in this paper.

The following important points may be noted in this connection :—(i) Copulation lasts as long as 20 to 40 minutes if the animals are left undisturbed. (ii) The animals, while copulating, do not separate if carefully handled, though even the slightest sound vibrations, *e.g.*, tapping of the table on which the dish containing the animals is kept, disturbs them. (iii) There is a period of excitement for the male after which it never likes to copulate (iv) There is a jerking movement every 3 or 4 minutes by which the gonopods press firmly against the vaginal discs, and this movement is very much pronounced at the end of the copulating process after which the animals separate. (v) Copulation is generally observed in nature from July to November. Copulation ceases during the winter months when the animals hibernate. (vi) Eggs may be laid on the third day after the last copulation, or as late as 5 to 9 or even 13 days after. (vii) Eggs do not develop

if even slightly exposed to air, hence eggs are laid singly in small egg-capsules of earth which serves for protection during development. As many as 31 egg-capsules were collected from a single female.

(3) *On the chemical nature and physiological significance of the so-called 'Stink-glands' of Thyropygus malayus :* (Indian Science Congress, Patna, 1933).

These glands lie on the lateral walls of the chitinous body rings but are absent from the first five segments, including the collum, and from the last or anal segment. They open outside as longitudinal slits through which comes out a yellowish pungent fluid when the animals are handled. On irritation, however, the animals pour out considerable quantities of this fluid.

Microchemical tests were applied for detection of hydrocyanic acid which is present in exceedingly small quantities. The author has also been able to detect minute quantities of free chlorine in the secretion.

The probable function of the glands is protective. Millipedes are quite unpalatable due to this fluid and very rarely preyed upon and eaten. Secondly, the hydrocyanic acid and free chlorine act as disinfectants and keep the surrounding soil and decaying vegetable matter where the animal lives free from bacteria and other micro-organisms.

Quantitative estimation of chlorine and hydrocyanic acid is being carried out. Details of the experiments are given in the paper.

(4) *On the egg-laying in Strongylosoma and Orthomorpha :* (Indian Science Congress, Patna, 1933).

Several local millipedes were collected and kept in the laboratory under observation. Eggs were laid in clusters and in small pits in the soil. Egg-laying begins early in the rains as soon as the animals come up on the surface. In *Strongylo-*

soma contortipes Attem., the number of eggs varied from 127 to 185 with different individuals. Eggs are red in colour. In another variety of *Strongylosoma*, viz., *Strongylosoma contortipes*.—forma minor—eggs varied from 78 to 93 in number and are pale yellow in colour; while in *Orthomorpha modestina* Silv., eggs are absolutely white and numbered from 38 to 60 with different individuals.

(5) *On the faecal pellets of millipedes:* (Indian Science Congress, Patna, 1933).

The millipedes are mainly vegetable feeders but they also swallow considerable quantities of earth along with their food, which they pass out in form of small beads. These faecal pellets resemble more or less the castings of *Pheretima* and measure about 5 mm. in length, and 1 to 2 mm. in width in case of *Thyropygus malayus*, but they are as small as mustard seeds in case of smaller millipedes. During burrowing the labrum works like a spade and the feet help in throwing the earth backwards, but a good quantity of the earth is swallowed.

(6) *On a cyclopian chick monster:* (Indian Science Congress, Patna, 1933).

This chick monster collected locally shows four developing wings and four posterior limbs. Head and other parts are normal.

Details of the monstrosities are discussed in the paper.

A. B. Misra.

A. B. Misra who took his D. Sc. degree from the University of Lucknow has published his thesis in the following papers :—

(1) *On a collection of lac Insects from Northern India*. (Bulletin of Entomological Research, Vol. 21, 1930).

(2) *On the Post-Embryonic Development of the female Lac-Insect, Laccifer lacca :* (Bulletin of Entomological Research, Vol. 21, 1930).

(3) *On the Anatomy of the Larva of Laccifer lacca :* (Bulletin of Entomological Research, Vol. 22, 1931).

(4) *On the Internal Anatomy of the Female Lac Insect Laccifer lacca :* (Proc. Zoological Society of London, 1931).

(5) *On the Internal Anatomy of the Male Lac Insect Laccifer lacca:* (Proc. Zoological Society of London, 1931).

The thesis comprises four sections made up of eight papers embodying the results of investigation on the anatomy, embryology and taxonomy of the Indian lac Insect of the genus *Laccifer* (*Tachardia*).

Section A.

The presence of two types of lac glands, their structure, distribution and function have been described for the first time. A full account of the gut and the histology of its separate parts has also been given. It has also been shown that the honey-dew is the liquid excrement of this insect, and that the stories of the symbiotic relationship between the ants and the lac insect are fictitious. The dorsal spine has been shown to be incapable of discharging any of the functions ascribed to it by Green. A detailed account of the muscular, tracheal, nervous and reproductive systems of the female lac insect has been given, and the observations of Carter, Stebbing and Imms have been emended or amplified. The structure and location of the wax secreting glands have also been dealt with.

In the section devoted to the male lac insect, the lac glands and the vascular system have been shown to be unrepresented, and a complete account of the digestive, tracheal, muscular, nervous and generative systems has been given. The presence of the oral and anal openings has been established beyond doubt. The caudal filaments of the male have been found to be due to the wax glands lying below the caudal pits. The formation of the resinous cell by the male and the structure of the ocellanae have also been dealt with. The mode of emergence of the male, its last ecdysis, general habits and mode of copulation have also been described in detail, and the duration of its life experimentally ascertained.

The external characters of the larva have been redescribed and the errors of previous workers rectified. The lac glands of the larva are all alike, and the wax glands occur in association with the anterior spiracular openings and round the anal opening. Salivary glands are present in the larva and are quite distinct from the thoracico-abdominal ganglion with which they were confused by Targioni-Tozzetti and Leydig in allied coccids. The gut, the nervous and tracheal systems have been fully described. The absence of secondary sexual characters of a morphological nature in the *first stage larva* has been indicated, and it has been emphasised that the differentiation of the male and the female takes place later in life, during post-embryonic development.

Section B.

The post-embryonic development of the male and the female lac insect shows many features of uncommon interest. The period of development of the male lac insect occupies 4—4½ months, during which the male moults four times, and the female thrice only. Besides the larval, pupal and the adult stages, a number of intermediate stages are intercalated between these in the case of the male. A detailed account of

all the stages, and the development and differentiation of the antennae, legs, wings, eyes, testes, vasa deferentia, thoracic and abdominal muscles, wax-glands, penis and its sheath has been traced from first to the last stage.

The development of the female is of an abnormal kind since, moult after moult, it departs from the form and structure of a typical insect and, ultimately, assumes a sac-like form in which the limbs have atrophied, surface limitations have been effaced, and the visceral and alary organs are unrepresented. All the developmental stages of the female and the external and internal changes involved in the process have been set forth cogently.

SECTION C.

As a result of the examination of a collection of lac insects from northern India, six species new to science are recorded. They are *Laccifer longispina*, *L. kydia*, *L. pusana*, *L. ambigna*, *L. jhansiensis* and *L. indica*.

SECTION D.

The local conditions of lac cultivation in the Punjab and Sind have been surveyed as a result of an extensive tour in the lac growing tracts of these provinces. The areas have been mapped and suggestions made for the improvements of lac culture which is deteriorating in these parts. Material for ecological and taxonomic work was collected during the tour and utilised for preparing Section C of the thesis.

B. B. Sinha.

On the morphology and systematic position of Cephalogonimus magnus n. sp. from Trionyx gangeticus: (Annals and Magazine of Natural History, Ser. 10, Vol. X, p. 419, October, 1932).

A large number of specimens were obtained from the intestine of *Trionyx gangeticus* at Lucknow. The chief peculiarities are:—

(*i*) Anterior half of the body is covered over with spines, (*ii*) Oesophagus is as big as the muscular pharynx, (*iii*) The excretary vesicle is longer than the arms of 'Y', (*iv*) The uterus completely fills the posterior part of the body and can be distinguished into ascending and descending rami, (*v*) The yolk-glands are in the middle third of the body, extending beyond the posterior margin of the acetabulum, and (*vi*) An elongated, flask-shaped cirrus sac with a long narrow neck is present.

The new species differs from other members of the genus in its larger size and in the extent of the vitellaria.

The paper concludes with a discussion on the systematic position of *Prosthogonimus* which has recently been included in the family Lepodermatidae by Poche (1925) The author has argued for the exclusion of *Prosthogonimus* from the family Lepodermatidae and has advanced his arguments in favour of its inclusion under the family Cephlogonimidae along with the genus *Cephalogonimus*.

DEPARTMENT OF MATHEMATICS.

During the period under review **Avadesh Narayan Singh** has communicated the following original papers. Titles are in chronological order. All have not yet appeared in print. The Journal of the Benares Mathematical Society is an irregular publication, and the papers mentioned in connection with it should have been published from one to three years ago:

(1) *On the mean value theorem of the differential calculus*. (Bull. Cal. Math. Soc. XIX. 1928).

(2) *On Bolzano's non-differentiable function :* (Bull. de l' Academie Polonaise des Sciences et des Lettres, 1928).

(3) *On zero derivates :* (Proc. Benares Math. Society).

(4) *Some remarks concerning a result of Besicovitch :* (Bull. Cal. Math. Soc. XX. 1929).

(5) *On a class of arithmetic non-differentiable functions:* (Annals of Mathematics. XXXI. 1930).

(6) *On the derivates of a function :* (Bull. Cal. Math. Soc. XXII. 1930).

(7) *On the unenumerable zeros of Singh's non-differentiable function :* (Bull. Cal. Math. Soc. XXII. 1930).

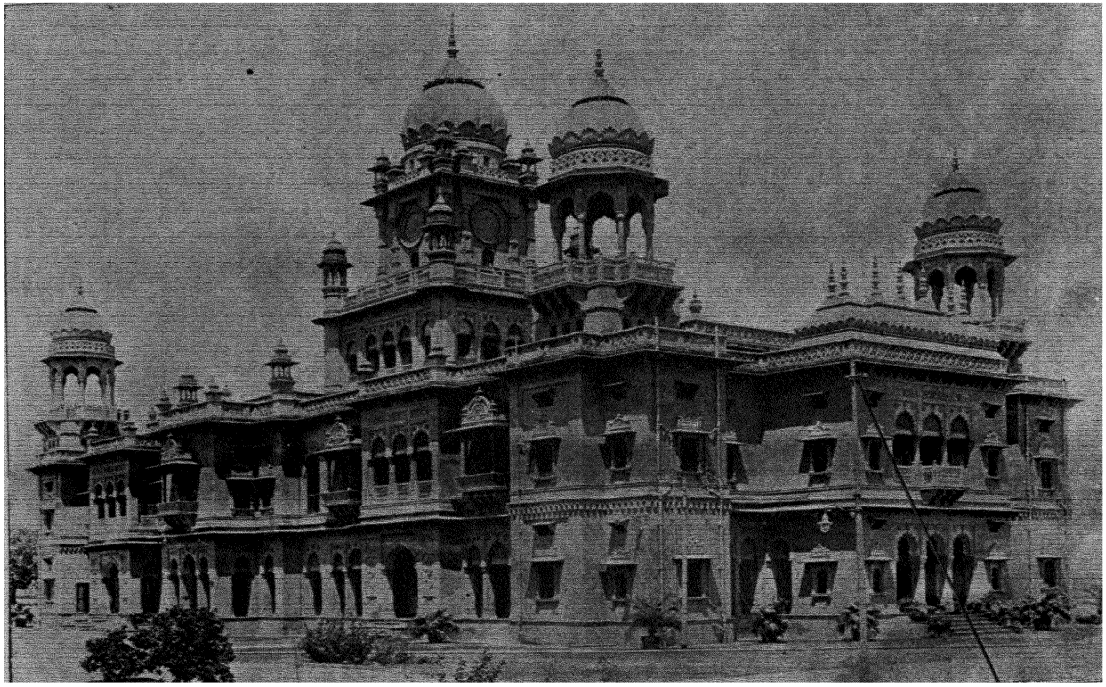
(8) *A note on unilateral derivatives of continuous functions :* (Proc. Benares Math. Society).

(9) *On the derivates of a non-differentiable function :* (Proc. Benares Math. Society).

(10) *On the existence of a derivative :* (Bull. Cal. Math. Soc. XXIII. 1931).

(11) *On the method of construction and some properties of a class of non-differentiable functions :* (Proc. Benares Math. Society).

(12) *Some remarks concerning a result of Boris Kaufmann :* (Bull. Cal. Math. Soc. XXIV. 1932).



MAIN BUILDING, KING GEORGE'S MEDICAL COLLEGE, LUCKNOW UNIVERSITY.

FACULTY OF MEDICINE.

Teaching Staff.

Anatomy –

1. Capt. B. S. Nat, M. B., CH B. (St Andrews), L.R.C.P. (Lond.), F.R.C.S. (Eng.), L.M.S., Professor.
2. Capt. J. N. Goil, M. B., B. S. (Alld.), Lecturer.
3. P. D. Mukerji Esq , L. M. S., Senior Demonstrator.
4. Sharda Prasad Srivastava Esq., M. B., B. S. (Luck.), Junior Demonstrator.

Physiology—

1. Dr. W. Burridge, M.A., D.M., B.CH. (Oxon.), L.M.S., S. A. (Lond.), Professor.
2. Dr. S. N. Mathur, M B., B.S. (Alld.), PH. D. (Lond.), Lecturer.
3. Hem Kant Sinha Esq., M.B., B.S. (Luck.), Senior Demonstrator.
4. Narindra Singh Esq., M.B., B.S. (Luck.), Junior Demonstrator.

Forensic Medicine—

Rai Bahadur J. P. Modi, L. R. C. P. & S. (Edin.), L. F. P. & S. (Glas.), Reader.

Pharmacology—

1. Rai Bahadur B. N. Vyas, M.B. (Panj.), Reader.
2. Dr. Bir Bhan Bhatia, M.D., B.S. (Luck.), M.R. C.P. (Lond.), Lecturer.
3. K. N. Sinha Esq., M. B., B. S. (Alld.), Demonstrator.

Pathology –

1. Lieut.-Colonel H. Stott, M.D., F.R.C.P., D.P.H. (Lond.), O.B.E., L.M.S., Professor.
2. Rai Bahadur Captain J. G. Mukerji, L.M.S. (Panj.), Reader.
3. Dr. Mohammad Abdul Hameed, M.B., B.S. (Alld.), M.D. (Luck.), M.R. C.P. (Lond.), Lecturer.
4. Amir Uddin Ahmad Esq., M.B., B.S. (Luck.), Senior Demonstrator.
5. Shanti Prakash Gupta Esq., M.B., B.S. (Luck.), Junior Demonstrator.

Medicine—

1. Lieut.-Colonel G. T. Burke, M.D., B.S., F.R.C.P. (Lond.), I.M.S., Professor.
2. Rai Bahadur Hargovind Sahai, M.B., B.S. (Panj.), Lecturer and Medical Registrar.

Surgery—

1. Rai Bahadur R. N. Bhatia, B.A., B.SC. (Alld.), M.B. (Panj.), F.R.C.S. (Edin.), Professor.
2. Rai Bahadur Raghunandan Lal Esq., M.B., B.S. (Panj.), Reader in Radiology.
3. Capt. Kali Sahai Nigam, M.D. (Alld.), F.R.C.S. (Edin.), D.T.M. (Lond.), Reader.
4. P. C. Kacker Esq., M.B., B.S. (Alld.), F.R.C.S. (Edin.), Lecturer and Surgical Registrar.
5. Raj Narain Kacker Esq., M.B., B.S. (Luck.), D.L.O (Royal College of Surgeons in England), Honorary Lecturer
6. R. D. Pramanick Esq., B.SC., M.B., B.S. (Alld.), Lecturer in Anæsthetics.
7. Dr. R. B. Goil, B.SC. (Benares), D.D.S. (Atlanta), Lecturer in Dentistry.

Ophthalmology—

1. B. G. S. Acharya Esq., B.A., M.B. & C.M. (Madras), L.R.C P. (Lond.), F.R.C.S. (Edin.), M.R.C.S. (Eng.), D.O. (Oxon.), Professor.
2. C. P. Misra Esq., L.M.S. (Panj.), Lecturer.

Obstetrics and Gynæcology—

1. Lieut.-Colonel H. C. Buckley, M.D. (Lond.), F.R.C.S. (Edin.), I.M.S., Professor.
2. Dr. (Miss) G. Stapleton, M.D., W.M.S., Reader in Diseases of Women and Children.
3. Miss A. Siret, M.B. (Cal.), I.M. (Rotunda), D.G.M. (Dublin), Lecturer in Midwifery.

State Medicine—

Rai Bahadur D. D. Pandya, L.R.C.P. & S. (Edin.), L.F.P. & S. (Glas.), D.P.H. (Cantab.), Professor.

DEPARTMENT OF ANATOMY.

(*a*) *Papers published*:

B. S. Nat and P. D. Mukerji.

(1) *Abnormal Duodenum:* (Journal of Anatomy, Vol. LXIV, Part II, January, 1930).

B. S. Nat.

(2) *Estimation of Stature from long bones in Indians of U. P.*—(A Medico-legal Inquiry in Anthropology): (Indian Journal of Medical Research, Vol. XVIII, No. 4, April, 1931).

(*b*) *Paper read:*

B. S. Nat.

Experimental Embryology: (King George's Medical College Clinical Society, 1928).

(*c*) *Techniques examined and introduced:*

Reconstruction work from a series of Embryological Sections was carried on and a wax model of Heart from the pig's Embryo of 6 mm. length has been prepared.

(*d*) *Other Research:*

(1) Anthropometrical work on carpus, tarsus and lumbar vertebrae in Indians of U. P. was carried on.

(2) Comparative study of the muscular system and the abdominal viscera of cercophithecidie was carried on.

DEPARTMENT OF PHYSIOLOGY.

(*a*) *Books published :*

W. Burridge.

(1) *Indigenous Systems and Medical Science:* (Pioneer Press, Allahabad).

(2) *Excitability, A Cardiac Study :* (Oxford University Press, 1932).

(3) *The New Physiology of Sensation:* (Oxford University Press, 1932).

C. S. Thaker (officiated as Professor in 1928).

Synopsis of Physiology : (The book was published during his term of office).

(*b*) *Papers published :*

W. Burridge.

(1) *On the Composition of Excitation process, with a note on after-images:* (Quarterly Journal of Experimental Physiology, Vol. 18, No. 4, May, 1928).

(2) *On the Excitation Process of the Conscious and the Subconscious Mind:* (Journal of Mental Science, Vol. XXXV, No. 310, July, 1929).

(3) *On the Excitation process of Fits and other convulsive and emotional states:* (Ibid, July, 1929).

(4) *On the Significance of Double Nerve supplies:* (Ibid, July, 1929).

(5) *On the Neural mechanism of Fanaticism:* (Ibid, October, 1929).

(6) *On Sex Variations in Neural mechanism:* (Ibid, October, 1929).

(7) *The Cardiac all or none Law:* (Quarterly Journal of Experimental Physiology, Vol. XIX, 1929).

(8) *On Memory:* (Journal of Mental Science, 1930, LXXVI, page 96).

(9) *On Pain:* (Journal of Mental Science, 1930, LXXVI, page 101).

(10) *On Seeing:* (Journal of Mental Science 1930, LXXVI, page 103).

(11) *On Peptones:* (Archives Internationales de Pharmacodynamie et de Thérapie, 1930, XXXVII, page 189).

(12) *Experiments with Alanine:* (Ibid, XXXVIII, page 42).

(13) *On the Sense of Effort:* (Journal of Mental Science, April, 1931).

(14) *On Protopathic and epicritic Sensations:* (Ibid).

(15) *On the Divisions of Mind.* (Ibid).

(16) *A Further note on the possible structures mediating Mind:* (Ibid).

(17) *On Writer's cramp and other occupation neuroses:* (Ibid).

(18) *On Dreams and theories:* (Ibid).

(19) *On Freud:* (Ibid).

(20) *On Janet:* (Ibid).

(21) *On the mechanisms of personality.* (Ibid, October 1931).

W. Burridge in a series of papers published in the Journal of Mental Science has applied some of the results obtained by him on hearts in explanation of others of the nervous system. He has further summed up some of the results obtained by him in two books which have been published by the Oxford University Press, the first is called (1) *Excitability, A Cardiac Study;* the second is called (2) *The New Physiology of Sensation.*

In this book, Excitability, it is shown that there are two different phenomena of stimulation. There is first the excitation of a single response, or even a series of responses, in normally quiescent tissues, such as are the members of the excised muscle-nerve preparation, and quite possibly nothing else in medicine generally, or in physiology in particular, has been so much studied as this. There is next the quite different phenomenon of modifying by augmentation the activity of an already active rhythmical structure, a phenomenon previously almost entirely neglected.

The capacity of a rhythmical tissue to have its activity modified by augmentation has been termed its responsiveness, and this responsiveness is so different from the excitability studied in the muscle-nerve preparation that the rhythmical tissue which possesses much excitability has little responsiveness.

The evidence is further presented that the behaviour of end organs, such as those of the eye, and of reflex arcs has an exact parallel in the behaviour of a heart when its activity is augmented by an augmentation of the type which is termed hysteresial. Those who have hitherto worked with these tissues, however, have always presumed, without any actual positive evidence, that these tissues were primarily quiescent until roused to activity by a stimulus. But they always found that the behaviour they met in these tissues had no exact parallel in the behaviour they had met in the members of the muscle-

nerve preparation. Consequently they always required to frame an hypothesis to attempt to explain how it was that the other tissue did not quite behave as it presumably 'ought' to if, like the members of the muscle-nerve preparation, it were primarily quiescent and only became active on excitation. All such adjustive hypotheses, and Physiologists have produced many of them, are automatically discarded once it is realised that the differences of behaviour really present the evidence that end-organs and some one or more structures in the reflex arc are always in a state of rhythmical activity.

Inhibition, the chronaxie, fatigue, double nerve-supplies and many other phenomena are also dealt with in the book, Excitability, on the basis that the activities of the tissues of the body are ultimately phenomena of colloidal systems.

In the New Physiology of Sensation the phenomena of vision are re-examined from the standpoint of the presence in the retina of rhythmical end-organs which are stimulated to greater activity by light. In addition use is made of a new principle, one that should interest philosophers generally, namely that human minds are organs of finite understanding. Possibly there is none but would admit this, yet none seems to have previously suspected that this finiteness could make all the difference to man's interpretation of what he sees and feels. This finiteness, however, is found to determine an ability to distinguish four colours, different from all others and grouped into complementary pairs, a grouping already performed by Hering. But whereas it is now shown that the finiteness of the human mind automatically determines the ability to find four such primary colours, the previous tendency has been to look for chromo-excitatory substances in the retina instead. The last thing indeed that anyone has previously suspected was that the primary colours were essentially due to human minds having a limited capacity to detect changes in sense-organs.

W. Burridge and D. N. Seth.

(1) *Experiments with Sparteine:* (Archives Internationales de Pharmacodynamie et de Therapie, Vol. 34, No. 2, 1928).

(2) *Experiments with Adrenaline:* (Quarterly Journal of Experimental Physiology, Vol. XIX, 1929).

(3) *Experiments with Atropine:* (Archives Internationales de Pharmacodynamie et de Therapie, Vol. XXXIII, November, 1929).

S. N. Mathur.

(1) *Experiments on the Digestibility of Different Kinds of Rice and Rice Preparations:* (Indian Medical Gazette, September, 1928).

A large number of experiments was done to determine the digestibility of various varieties of rice and their preparations available in Indian bazaars. It is concluded that there are marked differences in the digestibility of different specimens of rice, and that parched rice is far more easily digestible than boiled rice. Further, experimental confirmation was found to support certain prejudices existing amongst Indians in respect of certain articles of diet derived from rice.

(2) *Experiments on Vitamin B (Anti-Neuritic Factor) in Parched Rice, in Honey, and the Mucous Secretion of Pigeon's Mouth:* (Indian Medical Gazette, January, 1930).

(*a*) It is shown that the parching of rice, as practised in India, is not only a better method of cooking rice from the digestibility point of view, but also is an ideal method for preserving its vitamin contents.

(*b*) Honey, held in very great popular esteem, is shown to be devoid of vitamin B contents.

(*c*) Importance of parental feeding has been demonstrated in pigeons; and may be true for all birds.

(3) *Studies on the Hydrogen-Ion Concentration of Saliva:* (Indian Medical Gazette, July, 1930).

It is shown that the common belief that the reaction of saliva is alkaline is only a partial truth, as well as, the opposite statement, found in some books, that it is faintly acidic. It is clearly demonstrated that its reaction is not fixed and, further, that its reaction regularly alters with meals on either side of neutrality.

(4) *Seasonal Variations in Cats:* (Quart. Journ. Expr. Physiol., London, March, 1932).

It is shown that physiological reactions in cats—which are probably true for all animals—vary with seasons. It is suggested that this may be an important reason of conflict in results got by different authors working on the same subject.

(5) *Inception of Blood Clotting:* (Biochem. Journal, London, 1932, XXVI, 853).

It is shown that the inception of blood clotting is started in the plasma and not in the formed elements. The change is of a physico-chemical nature, and is produced when the blood is exposed to a surface which it wets, or when it is exposed to a medium which abstracts water from it; both procedures act in changing the colloidal equilibrium of plasma-protein-complex.

(6) *Role of Tissue Juices in Thrombosis :* (The Lancet, London, August 20th, 1932).

Light has been thrown on the process by which tissue juices produce intra-vascular clotting. Some sort of previous change in the physico-chemical equilibrium in the plasma-protein-complex is a necessary condition before clotting can occur. There is a note on its clinical importance.

H. K. Sinha.

(1) *Observation on the Choleroid Epidemic, Lucknow, (1921):* (Journal of Tropical Medicine and Hygiene, London, December, 1930).

(2) *Some Experimental Observations on Caffeine :* (Archives Internationales de Pharmacodynamie et de Therapie, Vol. XLI, 59, 1931).

(3) *On the Cardiac responses to Radiated Heat :* (Ibid, Vol. XLII, Fac. III, 1932).

H. K. Sinha has performed many experiments relative to the actions of drugs on hearts when the experiments are performed according to the technique used in this department. As a result he has been able to confirm what others have found as the actions of those drugs on hearts, and in addition obtained other actions which were more in accord with clinical findings concerning the same drugs. This, it may be mentioned, almost regularly happens and indicates that the technique employed in this department more closely accords with clinical realities than do the techniques used elsewhere. Besides experimental work, a paper on statistical findings of clinical importance has also been published by him.

B. N. Vyas and H. K. Sinha.

(4) *Action of Centipeda Orbicularis :* (Indian Medical Gazette, February, 1930).

[*Note* :—Work was carried on in the Physiological Laboratory while **H. K. Sinha** was research scholar in Pharmacology].

N. J. Modi (officiated as Lecturer in 1931-32).

Experiments with Milk : (Arch. Internationales de Pharmacodynamie et de Thèrapie, Vol. XLIII, Fac. I, 1932).

N. J. Modi during his short stay in the department, made a number of experiments with milk. As a result he was led to conclude that what has so far been called protein-shock therapy should really be called protein-stimulation therapy. Some day, perhaps, it will be held as curious that the belief was once held that an injection of milk had curative properties because it delivered to the patient a sort of knock-out blow. The findings are quite definite that milk is a strong stimulant. It is further suggested in this paper that because milk is not a normal constituent of blood, it will maintain its stimulation until the blood develops mechanisms for destroying what is really an intruder. The development of such mechanisms, however, takes a week or so, an interval long enough to tide a patient over a crisis and put him on the road to convalescence.

N. D. Banerjee (Research Scholar).

(1) *Indian Dietetics in U. P. :* (Indian Medical Gazette, March, 1929).

(2) *Basal Metabolism of the Prisoners of the District Jail, Lucknow :* (Indian Journal of Medical Research, XIX, 1931).

N. D. Banerjee conducted investigations on the basal metabolism of the prisoners in U. P. jails He found that on an average this was some 9 per cent less than European standards, also that it was higher during the very hot but dry weather and then fell again to reach its lowest in the month of September. The inference drawn was that in respect of disease the soil was of importance as well as the seed. In Lucknow during September we not only have external conditions favouring the growth of the harbingers of diseases, but also changes take place in ourselves which weaken us in face of the attacks of our disease-enemies.

(*c*) *Papers read:*

W. Burridge.

(1) *Special Lectures delivered to mental experts at Dublin*— under the auspices of the Royal Medico-Psychological Association).

(2) *Importance of Colloids in Biology:* (The Indian Science Academy, 1931).

S. N. Mathur.

Technique of demonstrating and recording ciliary action by a new method: (Indian Science Congress, Madras, 1928).

N. D. Banerjee.

Indian Dietaries: (Indian Science Congress, Madras, 1928).

H. K. Sinha.

Some notes from experiments on the Visual field: (Ninth All-India Medical Conference, 1932).

(*d*) *Techniques examined and introduced*;

The Technique of using modified Ringer Solution as introduced by **W. Burridge** himself has been steadily followed with good results.

S. N. Mathur has introduced the Technique of working on ciliary movements.

(*e*) *Research* carried out in the department for Theses, for Scholarships, or for Fellowships.

(*i*) *Theses*.

S. N. Mathur.

Effects of Carbon-Dioxide on Circulation.

NOTE:—Although this work cannot be claimed to have com from this department it is worth recording here as it gaine for him the degree of Doctor of Philosophy, London.

N. D. Banerjee.

Basal metabolism of Indians: Thesis presented to the Lucknow University and accepted.

(*ii*) *Scholarships:*

N. D. Banerjee was granted the Kunwar Indrajit Singh Scholarship in the years 1928 to 1930 and carried on research *On Basal Metabolism of Indians.* The results are summarised elsewhere.

(*f*) *Other Research:*

D. D. Chatterjee is engaged on a study of the caloric values of the various vegetarian foodstuffs actually eaten and grown in the United Provinces.

DEPARTMENT OF PHARMACOLOGY.

The main feature of the Quinquennium under report is the establishment of the much needed Pharmacological laboratory both for research work and for teaching Experimental Pharmacology to the students. A grant of Rs. 10,000 was made in 1928 for this purpose and a new post of Lecturer in Pharmacology for the purpose of teaching Experimental Pharmacology and carrying on research in indigenous drugs was created. Dr. B. B. Bhatia, was appointed to this post. The laboratory was in full working order in 1929 and has done, since then very useful work on indigenous drugs besides raising the standard of Pharmacological knowledge of the students.

Though the laboratory is fairly well equipped for the work for which it was instituted, research work is much handicapped for want of a Pharmaceutical Chemist. Thanks to the co-operation of the Department of Chemistry of the Allahabad University, it has been possible to go on so far. If one of the Kamta Prasad Research Scholars is allotted to this department it will for the time being eliminate the great bar to continuous pharmacological research.

Indrajit Singh Research scholarship was awarded in this department to Dr. **H. K. Sinha** in 1929 for six months and to Dr. **S. Lal** from December 1931, who still holds it. Research work done by them is incorporated in this report.

The research work carried on has been mainly on indigenous drugs but recently some investigations have been started on the biological assay of drugs.

Research work on indigenous drugs resolves itself in two parts—(*a*) Clinical trial of those drugs which are described in the indigenous system to be of great therapeutic merit, (*b*) Pharmacological investigation of such drugs as are found useful on clinical trials or those whose active principles are sent to us for physiological tests.

DRUGS TRIED CLINICALLY.

(1) *Antimalarial drugs :*

(*i*) (" *Gurch* ") *Tinospora cordifolia.*

(*ii*) (" *Madar* ") *Calotropis gigantia.*

(*iii*) (" *Kanj* ") *Toddalia aculeata.*

These are some of the reputed Antimalarial drugs of the indigenous system and were given trial in a fair number of cases in which parasites were present in the blood. No specific anti-malarial action was observed with any of these within three to five days' trial as parasites were then found to be still present in blood, in fair numbers.

(2) *Anthelmintics :*

(*i*) (" *Ba-Barang* ") *Embelia ribes.*

(*ii*) (" *Kamala* ") *Mallotus phillippinensis.*

(*iii*) (" *Supari* ") *Areca nut.*

These are some of the well known indigenous anthelmintics and were given therapeutic trial in some cases of tape-worm infection. The results obtained with the first two were disappointing. The last one gave good results in two long-standing cases of tapeworm infection.

(3) *Leucoderma :*

(*i*) Solution of Plumbagin, 1 in 1000.

(*ii*) Fresh juice from leaves of Katumber (" *Ficus palmata*").

These two drugs were given trial in ten cases of leucoderma. Both tend to promote pigmentation in the de-pigmented patches. The result of our observation was that the effect produced was transitory in cases tried with Plumbagin and more lasting in those tried with Katumber. Further observations on the latter group are in progress.

(4) "*Karanja*" (*Pongamia glabra*).

This drug was given a therapeutic trial in cases of whooping cough. The results obtained were satisfactory. In six cases out of nine the severity and number of paroxysms were lessened and the period of recovery shortened. Freshly crushed Kernel was given in gelatine capsules in 1—5 gr. doses.

(5) "*Raniful*" (*Polygonum plebejum*).

A commonly growing weed was given trial for its reputed virtue as curer of bleeding piles. It was administered in powdered form in a few cases. The results were encouraging.

Pharmacological investigation :—On the following drugs was carried on :—

(1) "*Dudhi*" (*Euphorbia pilulifera*) :—Infusion and tincture prepared from freshly dried leaves showed broncho-dilatation and depressant effect on intestines. Small doses were found to stimulate the heart and large doses to depress it.

(2) "*Lalchitra*" (*Plumbago zeylanica*) :—It was established that the active principle of *Plumbago zeylanica* was Plumbagin* and that most of its pharmacological actions were due to the presence of this neutral principle. Plumbagin was found to belong to the group of general protoplasmic poisons having an irritant and germicidal local action and producing stimulant effect on heart, intestine, uterus and secretions of sweat, urine and bile (with small doses). Thus the use of *Plumbago zeylanica* in indigenous system of medicine as rubefacient, vesicant, ecbolic, diuretic and sudorific was found to have rational basis."

(3) "*Bœl*" *Aegle marmelos* :—Marmalosin an active principle obtained from bael fruits was investigated pharmaco-

*N.-B.—The active principles, *Plumbagin* (Plumbago zeylanica), *Marmalosin* (Aegle marmelos), of *Thevatoxin* (Thevetia nerifolia) were supplied to the department by the kind courtesy of Dr. S. Dutt, Reader in Organic Chemistry, Allahabad University.

logically but was found to have feeble action. The therapeutic usefulness in dysentry and diarrhœa of this fruit is probably due to the presence of tanins and not to this active principle.

(4) "*Nak-Chikni*" (*Centipeda orbicularis*) :—Chemically it was found to contain an alkaloid, a glucoside, some saponins and resins. Pharmacologically it was found to have a stimulant action on plain muscles of heart, intestine, blood vessels etc.

(5) "*Pila-kaner*" (*Thevetia nerifolia*) :—Thevetin a glucoside, isolated from this plant is under pharmacological investigation. Results obtained so far show that it has no toxic action on unicellular organisms but is extremely toxic to higher animals—average lethal dose in dogs being 0·5 mgm. per kilogram of body weight. In small doses it raises the blood pressure and stimulates rhythmic movements of intestine and uterus. Higher doses produce marked variations in blood pressure and failure of heart in diastole. Further work is in progress.

(6) *Taxus baccata* :—Chemically it was found to contain an ether soluble alkaloid, a glucoside and some resins. Pharmacologically it was found to have a depressant effect on plain muscle such as those of heart. Probably this accounts for its antispasmodic action observed clinically.

(7) *Biological assay and deterioration of tincture digitalis* :—It was found that tincture digitalis deteriorates at the rate of about ten per cent per month when stored under ordinary conditions at Lucknow. Pigeon emesis method of Hanzlick with certain modifications was found to give fairly accurate figures of potency as well as was capable of detecting deterioration. Five samples of tincture digitalis obtained from Lucknow Chemists and assayed by the pigeon method were found to have a potency of only 42 to 66 per cent of the international standard.

THE FOLLOWING CONTRIBUTIONS WERE MADE BY THE STAFF.

B. N. Vyas and Hem Kanti Sinha.

(1) *Centipeda orbicularis :* (Indian Medical Gazette, Vol. LXV, February, 1930).

B. N. Vyas and B. B. Bhatia.

(2) *On the failure of Toddalia aculeata in the treatment of malaria:* (Indian Medical Gazette, Vol. LXVII, No. 4).

B. B. Bhatia and S. Lal.

(3) *On the pharmacological action of Plumbago zeylanica and its active principle Plumbagin:* (Indian Journal of Medical Research, Vol. XX, No. 3).

B. B. Bhatia and J. H. Burn.

(4) *The action of Ether on the sympathetic nervous system :* (Journal of Physiology, Vol. LXXVIII, No. 3).

This work was done at the Pharmacological Laboratory of the Pharmaceutical Society of Great Britain, London, W. C. 1, during summer of 1932).

B. B. Bhatia.

(5) *On the scope of modern Pharmacology :* (King George's Medical College Clinical Magazine, Vol. XII, No. 2).

(6) *On some recent therapeutic advances :* (King George's Medical College Clinical Magazine, Vol. XII, No. 4).

(7) *A case of stone in bladder presenting peculiar symptom complex :* (Indian Medical Gazette, Vol. LXVII, No. 2).

(8) *On brain tumours :* (King George's Medical College Clinical Magazine, Vol. XII, No. 3).

(9) *On some common complaints of early childhood and their treatment :* (King George's Medical College Magazine, Vol. XV, No. 1).

(10) *On the deterioration and biological assay of tincture digitalis in India :* (Ninth All-India Medical Conference, 1932).

S. Lal.

(11) *A preliminary report on the pharmacological action of marmalosin :* (Ninth All-India Medical Conference, 1932).

DEPARTMENT OF PATHOLOGY.

Research in the Department of Pathology, otherwise than routine teaching, has been steady and continuous, and falls mainly under the following heads :—

I. The publication of books and articles, and professional communications to learned societies, by officers of the department.

II. The examination of new methods of technique for the better diagnosis of disease in the United Provinces ; especially as regards the influence of climate. Determination of standards for such techniques for healthy and for diseased Indians.

III. Assistance (1) to postgraduates undertaking research for theses for the higher University Degrees (M. D. and M. S.), so far as this may be legitimately given, (2) to research scholars holding the Indrajit Singh Research Scholarship, the University Fellowship, or engaged in other research.

IV. The investigation of individual cases in King George's Hospital of special scientific interest to clinical medicine and surgery.

V. The investigation in wards and laboratory of special diseases of importance in the United Provinces or in India.

VI. Research concerning the exhibition of specimens of Pathological interest for the Museum of Pathology.

I. Publication of Books, Articles and Professional Communications to Learned Societies.

(*a*) *Books:*

(1) *A Catalogue of King George's Medical College Pathology Museum:* (Newal Kishore Press, 1931)—**Stott, Mukerji, and Hameed.**

This work described, classified and numbered the 3,760 pathological specimens which had been collected in the Museum from India, Europe and elsewhere during the previous ten years.

(2) The following articles were contributed to *Conybeare's Text-book of Medicine*, Second edition, 1931, by **H. Stott:**

(i) Articles on Amœbic Dysentery, Bacillary Dysentery, Cholera, Sprue, Malaria, Blackwater Fever, Hepatic Amœbiasis, Leishmaniasis, Trypanosomiasis, Plague, Undulant Fever, The Relapsing Fever Group, Rat bite Fever, Spirochætosis. Ictero-Hæmorrhagica. The Typhus Group, The Dengue-Sandfly Fever Group, Yellow Fever, Dermal Leishmaniasis, Leprosy, Yaws and Mycetoma.

(*b*) *Articles:*

(1) *Standards for Maclean's Urea Concentration Test in Healthy Indians:* (Indian Medical Gazette, July, 1928)—**Stott and Mangalik.**

The standards for Europeans was known, but it was necessary to determine the normal standards for Indians, before the test could be usefully applied to nephritic Indians.

(2) *Seven cases of Diaphysial Aclasis (multiple exostosis) in Indians, including 4 cases from one family:* (Indian Medical Gazette, 1929)—**Stott and Raghunandan Lal.**

One case was photographed in life. An X-Ray composite photograph of his complete skeleton showing the deformities was also taken during life, and his skeleton after death was articulated, photographed and placed in the Museum of King George's Medical College.

(3) *Diaphysial Aclasis (Multiple Exostosis) in Indians:* (British Journal of Surgery, 1929)—**Stott and Raghunandan Lal.**

The cause of the condition is discussed.

H. Stott.

(4) *On Rheumatic Infection as a cause of Mitral Stenosis amongst young Indians:* (Indian Medical Gazette, February 1930).

A paper to emphasize the frequency of mitral stenosis in young Indians, that its cause is Rheumatic infection, and that much rheumatic disease must exist in India amongst children unrecognized and untreated, with disastrous effects on their hearts in early adult life. Not long ago it was thought that rheumatic fever did not affect Indians.

(5) *On the advisability of a routine Wassermann Test in every case of Diabetes Mellitus:* (Indian Medical Gazette, April, 1930).

The frequency of a positive W. R. in a long series of diabetic Indian admissions to King George's Hospital is recorded and the improvement under anti-syphilitic treatment is noted.

(6) *On the Distribution of Lathyrism in the United Provinces and on its cause:* (Indian Journal of Medical Research, July, 1930).

Beyond notes on the distribution and cause of Lathyrism, feeding experiments with suspected grains were conducted on three tonga ponies kept in the Pathology Laboratory.

(7) *The Distribution and cause of Endemic Goitre in the United Provinces, Part I Aetiology, Distribution and relation to Deafmutism :* (Indian Journal of Medical Research, April, 1931)—**Stott, Bhatia, Lal and Rai.**

This work summarises five years research on the clinical condition, ætiological factors and endocrine disturbance found in endemic areas. The distribution of endemic goitre and of deafmutism in the United Provinces and in India, and its relationship to calcium soils and waters is recorded.

H. Stott.

(8) *The naked eye and microscopic anatomy of goitre with special reference to Endemic Goitre of the United Provinces:* (Indian Journal of Medical Research, 1932).

The stages observed in the development and degeneration of endemic goitre in the U. P. are recorded.

(9) *The cause of endemic goitre and summary of prevention and treatment:* (Indian Journal of Medical Research, 1932).

In the U. P. it would appear that excessive calcium intake is a main factor in the production of endemic goitre, which fundamentally is probably caused by an upset in balance of calcium and of iodine intake. Calcium excess and iodine deficiency seem to operate as main individual or combined causes in different areas of the world.

(10) *The Scientific System of Medicine in India:* (Guy's Hospital Reports, 1932).

Contributed by request to the Sir William Hale White's Memorial Number.

(11) *A case of syphilis (Gummata of the Heart):* (British Medical Journal, 1932)—**Burke and Stott.**

A case of considerable clinical interest ended fatally and, at the postmortem, multiple gummata of the right auricle were found obstructing the venous return to the heart. No previous records of auricular gummata could be traced in the literature.

(12) *A case of Tabes Dorsalis in an Indian:* (Indian Medical Gazette, 1932)—**Abdul Hameed.**

This disease amongst Indians is most rare and by some is denied. Dr. Hameed places on record an unequivocal case.

(c) *Papers communicated to and read before Scientific Societies.*

A.—(U. P. Public Health Associatiod, 1930):

(1) *Lathyrism*—(a sequel of famine period in the United Provinces)—**Stott.**

B.—(Seventeenth Indian Science Congress, Allahabad, 1930):

(2) *The Wassermann Test in Diabetes Mellitus:* **Stott.**

(3) *Lathyrism in the United Provinces:* **Stott.**

(4) *Rheumatic Infection in Indians:* **Stott.**

C.—(International Congress of the American Association for the Study of Goitre, Ontario, 1932) :

(5) *The distribution and cause of goitre in India:*

Stott, Bhatia, Lal, and Rai.

This contribution was awarded second honourable mention, and the pathological and other exhibits connected therewith received the highest praise.

D.—(The All-India Medical Conference, Lucknow, 1932) :

(6) *Diabetes Mellitus in Indians:* **Stott.**

The practical classification of this disease as it affects Indians into " Fat or Dietetic " and " Thin or primary pancreatic " types is emphasized, as also the desirability of the subdivision of the " Fat or dietetic Diabetes " into four stages, (1) of preglycosuria, (2) of intermittent symptomless glycosuria, (3) of constant profuse glycosuria with symptoms and (4) of arterio-sclerosis. Likewise the subdivision of Thin diabetes into three stages of, (1) acute wasting, (2) of Ketosis and (3) of Ketogenic Coma is described. The successful treatment and prevention of the Fat type is briefly referred to.

(7) *Some observations on the causation of the so-called Endemic Ascites:* **Hameed.**

Two aetiological factors (malaria & poverty) are emphasized which produce, (1) Vitamine A deficiency, (2) a subinfection of the intestinal mucous membrane with (3) toxic absorption *via* the portal veins to the liver and a hepatic cirrhosis of both inter and intra-lobular type.

(8) *A case of Congenital Aortic Stenosis in a boy of 16:* **Hameed.**

An aortic systolic thrill and murmur were present, the latter of which was traceable along the carotid arteries, left-sided

heart hypertrophy and absence of the aortic second sound with a characteristic pulse were also noted. Sudden death.

II.—THE FOLLOWING NEW TECHNIQUES WERE EXAMINED and after trial introduced in the routine of the Pathology Department. The work has largely been based on the more recent advances in biochemistry.

Clot Culture :

A modified technique of clot culture has been adopted after research in our laboratories whereby the serum with its bacteriolytic and bactericidal properties is first eliminated and then distilled water is added. The latter has the advantage of dissolving the clot and liberating the entangled organisms inside the clot and further supplying a rich haemoglobin-containing medium which increases the percentage of positive cultures than hitherto has been the case.

Blood Calcium :

Kramer's method is used. Research has shown that there is no difference between European and Indian blood calcium standard. It has been found of no value as guide to Tuberculosis Treatment.

Serum Chlorides :

No variations have been observed between the European and Indian standard.

Blood Cholesterol :

Bloor's method has been adopted and has been found to be efficient and reliable in Lucknow. Observations in our department definitely show that an Indian Blood cholesterol is lower than the European standard.

Blood Urea:

The usual McLean's method is used. Our trouble has been with the Soya Bean which unless obtained fresh, gives a vitiated result. An attempt is being made to grow the beans locally in the College grounds which may give an acclimatised seed and a more uniform result.

C. S. Fluid Chlorides.

The ordinary silver nitrate method has been adopted with reliable results. The Indian standard has been found the same as for Europeans in diseases of the same type such as Tuberculosis etc.

Kahn's Test:

Uniform and parallel tests were done from Sera sent for Wassermann's test. Kahn's test was found to have the advantage of a quick result, earlier appearance and later disappearance, thus giving a help in both diagnostic and therapeutic purposes respectively but has the disadvantage of picking up false positives besides being useless for Cerebro-Spinal Fluid tests.

Diastase Test:

McLean's method giving an uniformly satisfactory result.

Rosenthal's Test:

One of the most costly Tests we have adopted. It is a very delicate test and shows the liver defect much earlier than does the Levulose Tolerance Test—which we have found only useful in grosser lesions.

Blood Cell Calculator:

A mechanical instrument introduced into the department and which has been a real help in lessening fatigue and in increasing

accuracy from the ordinary tiring method of calculation of different varieties of leucocytes—a fact that can be well realised when a very large number of such calculations have to be done.

A Photo-micrographic apparatus has been installed with a view to keep a record of all interesting smears and sections both in routine and research work in the Laboratory.

III (A) (*a*).—THE FOLLOWING THESES for the M. D. Lucknow, were presented from Demonstrators of the Pathology Department largely on research work undertaken by them in this department.

(1) *Some observations on Blood Sugar in Health and Disease:* (1928)—**V. S. Mangalik.**

(2) *Some observations on cases of Endemic Ascites:* (1928). **R. S. Lal.**

(3) *Observations on the chemical activity of the Stomach with an attempt at establishing an Indian Standard curve of acidity after a fractional test meal:* (1929)—**H. N. Bhatt.**

(4) *On the Pathogenesis of Endemic Ascites:* (1930)—**M. A. Hameed.**

(5) *Important Tests of Liver disfunction:* (1931)—**S. S. Misra.**

(6) *A study of the comparative value of blood and of clot culture:* (1932)—**Amir Uddin Ahmed.**

(7) *Preliminary observations on cases of chronic nephritis attending the medical wards of King George's Hospital:* (1932)—**S. P. Gupta.**

(*b*)—The following candidates carrying out research work for a thesis for the M. S. Lucknow, were helped in their

research to a legitimate extent by officers of the Pathology Department.

(1) Mr. A. C. Ghose, M.B., B.S.
(2) Mr. S. N. Mathur, M.B., B.S.
(3) Mr. A. H. Siddiqi, M.B., B.S
(4) Mr. P. D. Srivastava, M.B., B.S.
(5) Mr. K. L. Dutta, M.B., B.S.
(6) Mr. S. P. Srivastava, M.B., B.S.
(7) Mr. R. N. Misra, M.B., B.S.
(8) Mr. S. C. Misra, M.B., B.S.

III (B).—The following scholars researched largely or entirely from the Pathology Department :—

A.—Kunwar Indrajit Singh Scholars.

V. S. Mangalik	Diabetes in Indians.
C. P. Tondon	Ankylostomiasis.
A. C. Ghose	Cholesterol Metabolism in Cholecystitis.
S. P. Gupta	Endemic Goitre in Gorakhpur and Himalayan Districts.

B.—On Goitre Research.

K. C. Rai	Endemic Goitre in the Bahraich District.
R. S. Lal.	Endemic Goitre in Gorakhpur District.
V. S. Mangalik	On Goitre.
S. P. Gupta	Endemic Goitre in Gorakhpur and Himalayan Districts.

C.—University Research Fellowship.

R. S. Lal	Endemic Goitre in Himalayan District.
A. C. Ghose	Cholecystitis and Cholelithiasis.

IV.—Investigations on Pathological Material is undertaken by the Pathology Department for the Physicians and Surgeons of King George's Hospital and under special conditions for Hospitals elsewhere in the United Provinces. Such investigations have increased remarkably in the past quinquennial period, as compared with two former periods.

Investigations of	Quinquennial Period.		
	1918-1922	1923-1927	1928-1932
1. Blood	3,328	9,606	27,170
2. Stool	1,075	1,458	2,513
3. Urine	786	1,172	1,590
4. Pus and Exudates	663	956	2,323
5. Spinal Fluid	55	103	487
6. Stomach contents	55	103	2,846
7. Sections...	677	1,267	2,388
8. Vaccines	189	103	264
9. Animal experiments ...	70	39	60
10. Post Mortem	75	138	240
Total ...	6,964	14,945	30,803

There has therefore been a fivefold increase in the number of such specimens examined during 1928-1932 as compared with 1918-1922, and a twofold increase as compared with 1923-1927.

V.—The following diseases of special importance in the United Provinces or in India have been selected for continuous investigation by officers of the Pathology Department.

(1) Diabetes in Indians.
(2) Goitre in the United Provinces.
(3) Serological Tests for Syphilis.
(4) Endemic Ascites.
(5) Heart Disease in Indians.

VI.—Research concerning the exhibition of specimens of pathological interest for the Museum of Pathology, 1928-1932.

(1) *Macroscopic Museum.*

Investigations in correspondence with the Royal Chest Hospital, London, concerning the preservation of thick slice preparations of diseased organs in formalized gelatine. Some 30 of such were added to the museum. Methods of presentation of naked-eye specimens are constantly improvised and improved. In correspondence with the Pathology Department of Guy's Hospital, London, and from post-mortems in Lucknow some 466 specimens were investigated and mounted in the museum.

(2) *Microscopic Museum.*

A museum of Microscopic Pathology was instituted and some 168 specimens illustrating typical disease processes were mounted permanently in locked box microscopes, available at any time for student study. Some 218 microscopic sections from Germany were investigated and added permanently to the microscopic section museum.

(3) *Whole Organ Microscopic Sections.*

In correspondence with Professor Christeller of Berlin a series of 123 whole organ microscopic slice preparations were investigated and added to the museum.

(4) *Lantern slide Museum.*

A collection of lantern slides illustrating pathological processes, some made from photographs of interesting diseases from the wards of King George's Hospital and some from specimens in our Museum and some from subjects of research, has been arranged for the routine teaching of Pathology.

DEPARTMENT OF SURGERY.

Research in the Department of Surgery has been conducted along the following lines :—

1. Investigation of the prevalence, the clinical picture and the methods of surgical relief of cases of abdominal tuberculosis.

2. Investigations of the Bacterial contents of the discharges from wounds and effect of commoner antiseptics on them.

3. Investigation into the circumstances leading to the preponderatingly large number of surgical patients applying for treatment at an advanced stage or when they have become inoperable : A plea for Preventive Surgery.

4. Characteristics of chronic cholecystitis and cholelithiasis in Indians.

5. On other points of interest occurring from time to time.

The publications from the Department have been :—

K. S. Nigam.

(1) *The Surgery of tuberculosis of the Ileo-Cæcal Region:* (Indian Medical Gazette, Volume LXV, No. 1, January, 1930).

The article draws attention to the following special features :—

(*a*) There is at present a growing incidence of non-pulmonary forms of tuberculosis in the United Provinces.

(*b*) Some cases clinically suggesting localised hypertrophic cæcal tuberculosis (tuberculoma of the cæcum) on opening the abdomen revealed tuberculous ulcerative lesions more or less well marked in or limited to termination of the ileum.

(*c*) Patients present themselves late for surgical aid.

(*d*) The milder operation of ileo-colostomy is attended with less shock than excision of the cæcum, and is perfectly well borne with relief.

(*e*) The frequency of tuberculosis of the abdomen is to be kept in mind in dealing with doubtful abdominal conditions, acute or chronic.

(2) *Diphtheria in a surgical wound:* (Indian Medical Gazette, Vol. LXVII, No. 3, March, 1932).

The points brought out in the article, in addition to the importance of investigation of the bacterial contents of the discharges from wounds especially in the tropics, are :—

(*a*) Surgical diphtheria of a wound only very occasionally occurs. It is the writer's first case showing this condition.

(*b*) The clinical features of special interest where the painful enlargement of axillary and groin glands on the diseased side, and the marked general depression. The urine, examined once

only, showed no albumin, though even its presence in a pregnant female might not have been of much diagnostic import.

(*c*) The rapid improvement of the cases shows that surgical diphtheria in an adult is not attended by serious consequences, and hence may be passed over undiagnosed.

(*d*) Diphtheria in a surgical wound may spread, as in this case, from the wound to the surrounding skin.

(3) *Preventive Surgery : Plea for a scheme of Preventive Surgery :* (Indian Medical Gazette, Vol. LXIV, No. 6, June 1929).

The article draws attention to the tremendous toll the surgical diseases take of the population of India, because they frequently reach the surgeon in a hopelessly advanced and neglected state. Great majority of patients suffering from tumours apply for treatment at a much later stage than the corresponding patients in Europe.

(4) *Preventive Surgery :* (A paper contributed to the All-India Medical Conference, Lucknow, in December, 1932).

The paper detailed the description of surgical diseases reaching the surgeon hopelessly delayed. It brought out the following points :—

(*a*) Preventive Surgery is the Surgery of Choice.

(*b*) Hospitals in India give evidence that there is much scope of propaganda work to be done to enlighten the masses so that they may seek relief long before it is too late.

(*c*) Periodic physical examination of the population is the most efficient but costly means. Instruction of the public by pictorial placards for the illiterate and handy pamphlets in popular languages for others will be the only efficient way at present.

A. C. Ghose—(Research Scholar).

(1) *Blood cholesterol in Indians:* (Clinical Society Journal, Lucknow, No. 3, 1931).

Average blood cholesterol contents was found to be 145 m. g. per 100 c. c. It rises after a meal rich in fats and returns to normal in 5 or 6 hours.

(2) *Icterus Index, its significance in the surgery of the biliary tracts:* (Indian Medical Gazette, 1931, No. 10).

The normal icterus index was found to be ranging between 3 and 6. It was of some prognostic importance in cases of jaundice.

(3) *The blood cholesterol in Anæsthesia*: (Journal of Physiology, London, 1932).

The blood cholesterol was found to be increased during anæsthesia of chloroform and ether.

(4) *The cholesterin contents of blood in Indians and its significance in jaundice:* (Accepted for publication in the Indian Journal of Medical Research).

The values of plasma cholesterol in Indians are estimated and their utility in the diagnosis and prognosis in jaundice is discussed.

(5) *The significance of blood cholesterol in the surgery of the genito-urinary system:* (Accepted for publication in the Indian Journal of Medical Research).

The blood cholesterol determination in the calculus and other inflammatory diseases of the genito-urinary system did not prove of any significance.

(6) *On the bacterial infection of the gall-bladder, a clinical study in Human subjects and an experimental study in rabbits :* (Accepted for publication in the Indian Journal of Medical Research).

Bacteriology of the human gall-bladder was carried out. B. Coli was found the most frequent organism. An experimental study on rabbits was done by intravenous injections of B. Coli isolated from human gall-bladder.

(7) *Cholesterosis of the gall-bladder in Indians :* (Accepted for publication in the Indian Journal of Medical Research).

One-fifth of the cases operated for inflammatory and calculus diseases of gall-bladder show cholesterosis. Cholesterosis has been experimentally produced in rabbits.

(8) *Experimental production of gall-stones :* (A paper read before the All-India Medical Conference, Lucknow, 1932).

It has been shown that high cholesterol diet in rabbits gives rise to hyper-cholestraemia and also concretions in the gall-bladder.

(9) *Gall-bladder diseases in Indians :* (A thesis submitted for the M. S. (Surgery) and accepted).

The thesis discusses the aetiology, symptomatology and statistics of gall-bladder diseases in Indians. Concentration of bile and increased blood cholesterol are important factors in the causation of gall-bladder disease. Ths histology of diseased gall-bladders has been recorded.

Among other subjects that have excited interest and have been investigated are the following :—

Cultural tests for finding out whether human or bovine type of Bacillus tuberculosis is the organism present in cases of surgical tuberculosis in the United Provinces have been and are being done by **K. S. Nigam** in collaboration with **J. G. Mukerji** (Pathology Department). The research is still in progress.

Examination of the stained smears from the ordinary infected casualty and other wounds show that a persistent discharge is due to mixed infection by staphylococcus aureus with a saprophyte or anaerochic organism in majority of cases. The best method of combating this infection is not so much any specific antiseptic as is the continuous irrigations with saline or any weak antiseptic for 48 to 72 hours after the wound is freely laid open to allow free drainage.—**K. S. Nigam.**

The undernoted important observations were made :—

(1) Early laminectomy for traumatic paraplegia with complete recovery. It was noted at operation in such cases that the cord below the seat of bony lesion was not pulsating while laminectomy was followed by restoration of the pulsation. **K. S. Nigam**, 1930-31.

(2) Use of intravenous hypertonic saline very successful in averting threatened intestinal obstruction and in relieving the dynamic or paralytic part of a mechanical Ileul.—**K. S. Nigam**, 1930-31.

(3) Haemophilic arthritis treated with calcium intravenously as well as intra-articular injection of horse serum with success.—**K. S. Nigam**, 1931.

Interesting and important operations performed :—

(1) Thoracoplasty for unilateral pulmonary tuberculosis.

(2) Nephrectomy and pyelolithotomy for tumours and stones of the kidney.

(3) Opaque ureteric catheterizations for ureteric obstructions.

(4) Gastrojejunostomy for pyloric obstruction.

(5) Cholecystog-astrostomy for chronic sclerosing pancreatitis.

(6) Avulsion of Phrenic nerve for unilateral basal pulmonary tuberculosis.

(7) Bone pegging for ununited fractures.

(8) Cholecystectomy and choledochostomy for cholecystitis and cholelithiasis.

(9) Hydrocephalus and Acrocephaly treated by ventricular punctures and antisyphilitic measures.

(10) Diagnosis of Acute Hæmorrhagic Pancreatitis confirmed by Laparotomy in a young married girl of 19 years.

S. N. Mathur.

Enlargement of Prostate in Indians: (A thesis submitted and accepted for M. S., Lucknow University. 1928).

A. H. Sidique.

Classification of various types of ulcers in Indians: (A thesis submitted and accepted for M. S., Lucknow University, 1930).

P. D. Srivastava.

Hydrogen-ion Concentration in Anæsthesia: (A thesis submitted and accepted for M. S., Lucknow University, 1931).

S. P. Srivastava.

Chronic appendicitis in Indians—its pathology, and its relation with the symptomatology and operative end-results: (A thesis submitted and accepted for M. S., Lucknow University, 1932).

R. N. Misra.

Etiology of Appendicitis: (A thesis submitted and accepted for M. S., Lucknow University).

Radiology Section.

(*a*) *Papers published*:

(1) *Diaphysial Aclasis* (*Multiple exostosis in Indians*): (British Journal of Surgery, Vol. XVI, No. 64, 1929)—**H. Stott and Raghunandan Lal.**

(2) *Certain movements of the Lung and the effects of Phrenic Evulsion thereon*: ("Tubercle", May, 1931)—**C. A. Sprawson and Raghunandan Lal.**

(*b*) *Technique examined*:

Cholecystography Tetra Iodo Salts under various proprietary names of "Chole Pulvis and Shadocol."

DEPARTMENT OF FORENSIC MEDICINE.

J. P. Modi, Head of the Department.

The following is a statement of the work done in this department during the last five years:—

(1) The third edition of my *Elements of Hygiene and Public Health* was published as a University publication in 1928 by Messrs. Butterworth & Co., (India) Ltd., Calcutta. It contains 645 pages and is a text-book in some medical schools and colleges of India. I have made every effort to

bring this edition up to date by necessary additions and alterations in almost all chapters and by adding a new chapter on Venereal Diseases. New sections on Filariasis, Trypanosomiasis, Phlebotomus fever, Hookworm disease, Anthrax, Maternity and Child Welfare have also been introduced.

(2) The fourth edition of my *Text-book of Medical Jurisprudence and Toxicology* was published as a University publication in July, 1932, by Messrs. Butterworth & Co., (India) Ltd., Calcutta. It contains 1003 pages in addition to 121 pages of the appendices. It has been recognised as a text-book in almost all medical schools and colleges and also as a book of reference in Courts. The unique feature of the present edition is the insertion of several illustrations taken from the photographs of the cases which came under my observation as a Medico-legal officer and the incorporation of illustrative cases taken from my case books.

(3) I have been able to add to the Medico-legal section of the Pathological museum a very large number of photographs, specimens of bones, organs and poisons of Medico-legal interest, with the valuable assistance of J. G. Mukerji of the Department of Pathology. A medico-legal section of the Pathological museum as a separate entity is a unique feature of this college.

DEPARTMENT OF STATE MEDICINE.

D. D. Pandya, Head of the Department.

In addition to the routine analytical work of testing samples of water, ghee, milk, sweets, ærated water, disinfectants, urine, and faeces, the following special work was carried out at the Provincial Hygiene Institute :—

(1) Chemical analysis of water from goitre area for the Professor of Pathology.

(2) Samples of water from sulphur springs at Dehra Dun and in Vindhya range near Mirzapur, 1930, and Mineral spring Brindhkhal at Benares, 1929.

(3) Investigation of defects in the water-works at Hardwar (1931), Agra (1932), and Lucknow (1929 and 1930).

(4) Investigation in connection with an undiagnosed illness among coolies in the Terai forests of Sitapur.

(5) Investigation in connection with an outbreak of Jaundice in Fatehgarh Central Jail.

(6) Investigation in connection with the relative efficiency of different methods of storing of milk after boiling, judged by Bacteriological Examination of milk.

(7) Urine, blood and stool from an epidemic of fever in Lansdowne Cantonment.

(8) Hook-worm infestation in Lucknow Jail.

(9) Bacteriological tests of Paterson filter units installed in 1930 at Lucknow, carried out for certifying their coming up to the standard before they were put in use.

No research work was carried out in the department of State Medicine.

In addition to the above investigative work, a book entitled *The Chemistry and Bacteriology of Public Health* under the joint authorship of **C. L. Dunn**, Director of Public Health, and **D. D. Pandya**, was published in 1929. The book is meant to serve as a laboratory handbook for all students for the practical portion of examinations in Public Health and to be a companion to the various books on Hygiene which deal chiefly with the subject matter for Part II of the examinations for the Diploma in Public Health.

FACULTY OF COMMERCE.

Teaching Staff.

Commerce –

1. B. N. Das Gupta Esq., B.A. (Cal.), A.S.A.A., Incorporated Accountant, Reader.
2. Dr. D. Pant, B. COM. (Bom.), PH. D. (Dublin), F. R. ECON. S., Lecturer.
3. Saiyid Ahmad Husain Esq., B. COM. (Luck.), Lecturer.

Economics—

1. B. N. Chaterji Esq., M. A., B. L. (Cal.), Reader.
2. Om Prasad Gupta Esq , B. A. (Benares), B. SC. (Lond.), Lecturer.

This Faculty provides instruction up to the standard of the first degree and thus has no advanced students doing research work in collaboration with the teachers. The members of the teaching staff have contributed articles on the following special problems :

DEPARTMENT OF COMMERCE.

D. Pant.

(1) *Land Tenure in Kumaon :* (Indian Journal of Economics, January, 1929).

Mahalwari system is in vogue and the *Pudhan* plays an important part.

Patwari blasts the village life for with his revenue powers he combines large police powers.

Khaikars have been unjustly denied their full proprietary rights and *Sirtans* are debarred by custom to attain occupancy rights.

Changes in the laws of succession and in the granting of *Nayabad* are very necessary.

(2) *Credit and Banking Problems in India:* (Indian Journal of Economics, January, 1931).

Banks should also finance (a) intellect, (b) Industries, and (c) agriculturists.

(*a*) Banks in conjunction with Insurance Companies should take up this business. (A tentative proposal has been discussed).

(*b*) Long term credit can be manufactured by Industrial Banks so they should be founded. (A constructive proposal has been drawn up).

(*c*) The problem of ancestral debts should be solved by Land Redemption Banks in conjunction with Land Alienation Act and the problem of current debts can be tackled by co-operative societies.

(3) *Economic Depression with special reference to India.* (Indian Journal of Economics, January, 1933).

World depression is the legacy of Great War. It has been intensified by wrong gold fetish. India has suffered and is suffering much more on account of the following: (i) Dependency, (ii) Gandhism, and (iii) Loose organisation in political, social, religious, and economic fields.

Economic depression in this country will be a thing of the past if we can secure the following : (*a*) Mutuality of interest between the Government and people ; (*b*) Homogeneity in the people ; (*c*) Co-ordination between money-bags and brains ; (*d*) Unfettered working of the economic laws ; and (*e*) a human understanding of total humanity.

(4) *Advantages to the Agriculturist from the Co-operative Movement in the U. P.:* (U. P. Co-operative Vernacular Journal).

(i) Cheap credit, (ii) increase in literacy, and (iii) strengthening of moral values are some of the advantages. Less

Government control and more public co-operation will improve the tone of the Societies.

Plunkett Association is suggested as a model for this country.

Book.

Commercial Policy of the Moghals : (Foreword by the Rt. Hon'ble Lord Meston): (D. B. Taraporewala Sons & Co., 1930).

The book studies the reigns of Akbar, Jehangir, Shahjehan, and Aurangzeb from the standpoint of Commerce. It gives information on the following points :—

I. Extent of the Empire and the Organisation of the Government.

II. Routes and Transport System.

III. Land Policy.

IV. Labour availability and its distribution.

V. Capital Organisation : Currency and its regulation, Kothees, Hundees.

VI. Taxation.

VII. Manufactures : Raw Materials and their utilisation.

VIII. Trade : (*a*) General.
(*b*) Trade Centres.
(*c*) Inter-Provincial Trade.
(*d*) Frontier Trade.
(*e*) Foreign Trade.
(*f*) Government interference in and monopolies of Trade.

S. A. Husain.

Rural Reconstruction : (With the Editor, U. P. Co-operative Journal, for publication in the next issue).

The article deals with the problem of Rural Backwardness in India. Its causes are analysed and suggestions have been made for Rural Reconstruction on Co-operative lines. The working of the Credit movement and non-Credit Agricultural Societies is reviewed. The necessity of applying Co-operative principles to the cottage industries is also examined. In the end, Better-Living Societies have been recommended for improving the Social and moral condition of the people and for creating a rural community in the true sense of the word. Village opinion should be organised to make itself felt.

DEPARTMENT OF ECONOMICS.

B. N. Chatterji.

Why England went off the Gold Standard : (Modern Review, for publication in February, 1933).

Causes—external and internal—which turned the Balance of Trade against England in 1930. Decrease in England's exports, and her income from shipping, investments and other sources and increase in her imports discussed.

The banking and financial situation in France, America and the Continent examined and its reaction on the drain of gold from London discussed.

The Budgetary position of England examined.

The course of sterling-dollar exchange since 1931, traced and examined.

The consequence of the abandonment of the Gold Standard and the future prospect of the restoration of the standard in England.