THE NATIONAL ACADEMY OF SCIENCES, INDIA

ANNUAL NUMBER
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THE NATIONAL ACADEMY OF SCIENCES, INDIA

ANNUAL NUMBER

1955

SILVER JUBILEE SESSION

By

DR. S. P. MITRA, M. Sc., D. PHIL., F. N. A. Sc.,

Officer-on-Special Duty, National Academy of Sciences, India

The Silver Jubilee Session of the National Academy of Sciences, India was held at the University of Lucknow from 26th to 29th December 1955. This was the second time that an annual session of the Academy was held at Lucknow. This being the Silver Jubilee Session of the oldest scientific Academy in India, evoked keen enthusiasm among scientific workers throughout India.

The session opened with the address by Prof. M. N. Saha, the founder of the Academy. He traced the history of the Academy since its foundation and discussed the role that the Government can play in the development of science and technology in our country. He elucidiated the part that such Academies as this are playing in the development of natural resources in other countries. Unfortunately for the whole World of science and this Academy in particular, Professor Saha passed away soon after this session of the Academy.

Shri S. Basu, General Secretary of the Academy then read out the messages received for the occasion. Learned scientific societies including the Royal Society Academy of Sciences of U. S. S. R., National Academy of Sciences of United States, Institute of France etc., and world famous scientists wrote in glowing terms about the work of this Academy. In the words of Sir William Ogg :

"From modest beginnings twenty-five years ago the National Academy of Sciences, India, has grown both in size and prestige, until it is recognised throughout the world as a most distinguished body of scientists. Concentrating in the early stages, as was natural, on the local problems immediately confronting it, the National Academy has gradually but steadily widened its scope and its interests until at the present time its attention range over the entire field of scientific knowledge. In the words of Horace :

Nullius addictus jurare in verba magistri,
Quo me cumque rapid tempestas, deferor hospes.

The growth and expansion of the Academy itself has been mirrored, as is inevitable in its publications. Your earliest journal, the 'Bulletin of the Academy of Sciences, United Provinces of Agra and Oudh', gave place after three years to the 'Proceedings', which within eighteen months assumed the title under which it has come to enjoy a world-wide circulation, so that at the present time every scientific library of any pretensions regards the 'Proceedings of the National Academy of Sciences, India', for fifteen years now divided into two sections, as an indispensible member of its periodical section.

Stet fortuna Domus ! That this milestone in your development prove a stimulus towards even greater achievements in the future, is the sincere wish both of my colleagues and myself."

Dr. Radha Kamal Mukerjee, Vice-Chancellor of the University of Lucknow and Chairman of the Reception Committee offered a hearty welcome to the delegates. He discussed the relation between science, philosophy and religion. He concluded that if mankind has to outlive its crisis in the atomic age, will have to be educated in new sense of social equality and fellowship.

Prof. S. Ghosh, General Secretary of the Academy presented the Secretaries' report for 1955, and declared the office bearers of 1956. He also announced the award of Uttar Pradesh Government Education Minister's Gold Medal for 1955, for the best research papers published in the Proceedings of the Academy(1950-55) in Chemistry and Technology to Dr. S. P. Mitra, M. Sc., D. Phil., F. N. A. Sc., Lecturer in Chemistry, University of Allahabad on the unanimous recommendation of the judges. Prof. Ghosh also announced the names of 20 new fellows elected for 1955. Shri S. Basu, General Secretary of the Academy announced the name of 24 honorary fellows elected on the occasion of Silver Jubilee.

Prof. P. L. Srivastava, in his Presidential Address dealt with the development of the Academy since its foundation. He then described his researches in Dirichlet's series Dr. Sampurnanand, Chief Minister of Uttar Pradesh in his Inaugural Address termed the scientists as Brahmans of the present day society. He traced the role of fundamental research in the development of the country and appealed to the Acdemy to give a much needed lead of advancing the cause of science and bringing about the interlinking of scientific knowledge with a sound philosophical system which shall integrate all aspects of truth into one whole, radiating light into every corner of individual and communal existence. He also announced a prize of Rs.1,000 for any original work on "Space Travel."

The Physical Sciences Section was presided over by Prof. A. C. Chatterjee, where 34 papers were read and Biological Sciences Section by Dr. A. C. Joshi, where 48 papers were discussed. Five Symposia were held ; (1) Floods and their Control, (2) Physics of Solid State, (3) Role of Phosphates in the Soil Plant and Animal Kingdom, (4) Role of hormones in growth and reproduction and (5) Constitution of stars.

Popular lectures were delivered by (1) Prof. M. N. Saha, Director, Indian Association for the Cultivation of Science (2) Prof. N. R. Dhar, Director, Sheila Dhar Institute of Soil Science, University of Allahabad (3) Prof. W. D. West, Head of the Department of Geology, University of Saugar (4) Dr. B. Mukherjee, Director, Central Drug Research Institute, Lucknow (5) Prof. A. C. Banerjee, Vice-Chancellor, University of Allahabad and (6) Sri S. Basu, Director-General of Observatories, Indian Metorological Department, New Delhi.

200 delegates from all over India attended the session, which was a great success. Grateful thanks of the Academy are due to the Local Reception Committee, particularly to the two Local Secretaries Prof. A. C. Chatterjee and Prof. S. N. Das Gupta for the excellent arrangement made.

THE NATIONAL ACADEMY OF SCIENCES, INDIA

SILVER JUBILEE SESSION

PROGRAMME

MONDAY, 26TH DECEMBER, 1955

9-30 A.M. .. Annual Meeting at the A. P. Sen Hall of the University of Lucknow.

1. National Anthem.
2. Address by Prof. M. N. Saha, D. Sc., F. INST. F., F. A. S. B., P. R. S., F. N. I., F. R. S., F. N. A. Sc., Founder of the Academy.
3. Appointment of two Scrutineers by the President of the Academy to count votes.
4. Reading of Messages by Shri S. Basu, M. Sc., F. N. I., F. N. A. Sc., General Secretary of the Academy.
5. Welcome Address by Dr. Radha Kamal Mukerjee M. A., PH. D., P. R. S., Vice-Chancellor, University of Lucknow and Chairman of the Reception Committee.
6. Annual Report by Professor S. Ghosh, General Secretary of the Academy.
7. Address by Professor P. L. Srivastava, M. A., D. PHIL., F. N. I., F. N. A. Sc., President of the Academy.
8. Address by Shri C. B. Gupta, Minister of Health, Uttar Pradesh.
9. Presidential Address by Dr. Sampurnanand, Chief Minister of Uttar Pradesh.

10. Presentation of Uttar Pradesh Government Education Minister's Gold Medal for the best papers published in the Proceedings of the Academy in Chemistry and Technology.
11. Announcement of Honorary Fellows elected on the occasion of the Silver Jubilee of the Academy by Shri S. Basu, General Secretary of the Academy.
12. Announcement of Office Bearers for 1956 by Professor S. Ghosh, General Secretary of the Academy.
13. Vote of thanks to Dr. Sampurnanand, Chief Minister of Uttar Pradesh.
14. Vote of thanks to the University of Lucknow.
15. Photograph of Members, Delegates and Distinguished Guests.

1 P.M. to 2 P.M. .. Lunch Interval.

2 P.M. to 5 P.M. .. Symposium on "Floods and their control" under the Presidentship of Professor M. N. Saha, D. Sc., F. R. S., F. N. I., F. N. A. Sc., at the Physics Lecture Theatre.

5 P.M. to 6 P.M. .. Tea Interval.

6 P.M. to 7 P.M. .. Popular Lecture by Professor M. N. Saha on "Astrophysics in the Laboratory", in the A. P. Sen Hall.

7 P.M. to 8 P.M. .. Popular Lecture by Professor N. R. Dhar, on "India—the Hungriest Country in the World".

8 P.M. to 9 P.M. .. Dinner Interval.

9 P.M. to 10 P.M. .. Entertainment.

TUESDAY, 27TH DECEMBER, 1955

8-30 A.M. to 10 A.M. .. Excursions.

10 A.M. to 1 P.M. .. Symposium on "Physics of Solid State" under the Presidentship of Dr. K. S. Krishnan, D. Sc.,

F. R. S., F. N. I., F. N. A. Sc., in the Physics Lecture Theatre.

Symposium on "Role of Phosphates in the Soil, Plant and Animal Kingdom" under the Presidentship of Professor N. R. Dhar, D. Sc., F. R. I. C., F. N. I., F. N. A. Sc., in the Chemistry Lecture Theatre.

1 P.M. to 2 P.M. .. Lunch Interval.

2 P.M. to 5 P.M. .. 1. Meeting of Physical Sciences Section under the Presidentship of Professor A. C. Chatterjee, D. Sc., Dr. Ing., F. N. A. Sc., in the Physics Lecture Theatre.

2. Meeting of Biological Sciences Section under the Presidentship of Professor A. C. Joshi, D. Sc., F. N. I., F. N. A. Sc., in the Botany Lecture Theatre.

5 P.M. to 6 P.M. .. Tea Interval.

6 P.M. to 7 P.M. .. Popular Lecture by Professor W. D. West, D. Sc., F. N. I., F. N. A. Sc., on "The Birth of the Himalayas".

7 P.M. to 8 P.M. .. Popular Lecture by Dr. B. Mukherji, D. Sc., F. N. I., on "Ancient Indian Medicine and Drug Research."

8 P.M. to 9 P.M. .. Dinner Interval.

9 P.M. to 10 P.M. .. Entertainment.

WEDNESDAY, 28TH DECEMBER, 1955

8-30 A.M. to 10 A.M. .. Excursion.

10 A.M. to 1 P.M. .. Symposium on "Role of Hormones in Growth and Reproduction" under the Presidentship of Professor S. Ranjan, D. Sc., F. N. I., F. N. A. Sc., in the Botany Lecture Theatre.

Symposium on "Constitution of Stars" under the Presidentship of Professor A. C. Banerji, M. A., M. Sc., F. R. A. S., F. N. I., in the Physics Lecture Theatre.

1 P.M. to 2 P.M. .. Lunch Interval.

2 P.M. to 5 P.M. .. Continuation of Symposia and Sectional Meetings.

5 P.M. to 6 P.M. .. Tea Interval.

6 P.M. to 7 P.M. .. Popular Lecture by Professor A. C. Banerji, on "Flight in Space".

7 P.M. to 8 P.M. .. Popular Lecture by Shri S. Basu, M. Sc., F. N. I., F. N. A. Sc., on "Atomic Explosions and Weather."

MESSAGES

1. President, The Royal Society, London.

It is a source of great satisfaction to us, as it must be to the whole world of learning, that the oldest scientific Academy in India has maintained its high standards unimpaired. It has a long record of scientific activity to sustain it. It can look forward confidently to the great expansion of scientific endeavour in the present era and we have no doubt that it will continue to play a worthy part in the scientific advance of a great nation.

We wish it every success in the years to come and we send our warmest congratulations on its forthcoming Jubilee.

2. President, Academy of Sciences of U. S. S. R., Moscow.

U. S. S. R. Academy of Sciences warmly congratulate the National Academy of Sciences in Allahabad on its Silver Jubilee. Soviet scientists follow achievements of Indian colleagues with deep interest and sympathy. Strengthening scientific ties between Indian and Soviet scientists will promote fraternal friendship of our peoples. We wish you fruitful work and further success in the cause of developing science for the welfare of great Indian people.

3. President, Institut de France, Academie des Sciences, Paris.

Par une lettre en date du 22 novembre, vous avez bien voulu informer l' Academie des sciences de l' Institut de France de la prochaine celebration, par l' Academie nationale des sciences d' Allahabad, du XXVe anniversaire de sa fondation.

L' Academie des sciences de l' Institut de France serait heureuse de pouvoir prendre part a cette ceremonie par l' envoi de delegues mais il est peu vraisemblable que cela lui soit possible.

Quoiqu' il en soit, elle nous a charges de vous prier d' exprimer a l' Academie nationale des sciences d' Allahabad, ses felicitations et ses voeux les plus chaleureux.

Veuillez agreer, Monsieur le Secretaire general l' assurance de notre haute consideration.

4. President, National Academy of Sciences of United States of America.

On the occasion of the twenty-fifth anniversary of the founding of the National Academy of Sciences of India, it gives me sincere pleasure to send you and your distinguished colleagues hearty congratulations from the members of the National Academy of Sciences of the United States of America. The contribution of your scientists and scientific institutions to scholarship, knowledge and freedom of research earn the respect and admiration of all. Please accept our best wishes for a bright future.

5. President, Polish Academy of Sciences, Warsaw.

Polish Academy of Sciences send the warmest congratulations on occasion of the Silver Jubilee of the oldest scientific Academy in India. May the international cooperation of scientists develop for the prosperity of science and mankind.

6. President, National Research Council of Canada, Ottawa.

The National Research Council of Canada sends its greetings to the National Academy of Sciences, India on the occasion of its Silver Jubilee. We feel sure that the next fifty years will see a continuation of the spectacular rise of Indian science in which your Academy will play a major role.

7. President, Royal Society of New Zealand.

The New Zealand Royal Society extends greetings to your Silver Jubilee session.

8. President, Royal Society of Western Australia,

Congratualtions on your Silver Jubilee. Best wishes for the future of science in India.

9. Secretary, All China Federation of Scientific Societies, Peking.

On the occasion of the Silver Jubilee of the National Academy of Sciences, India, Allahabad, we send you our sincere greetings and wish to make efforts side by side with you for the developments of science of our two Nations and for the lasting peace of the World.

10. President, New York Academy of Sciences, New York.

The New York Academy of Sciences extends its most cordial greetings on the Silver Jubilee of the National Academy of Sciences of Allahabad, India and includes best wishes for continued success in the years ahead for outstanding achievements and progress in science.

11. President, Norwegian Academy of Science and Letters, Oslo.

Norwegian Academy of Science and Letters conveys its warmest greetings and congratulations.

12. President, Academia Sinica, Peking.

On the grand occasion of the Silver Jubilee of your Academy, please allow me on behalf of Academia Sinica to extend to you dear Mr. President and through you to the scientists of India our warm greetings and sincere congratulations. The Chinese scientists rejoice over the achievements of your Academy scored and wish your Academy more brilliant success in scientific research. The friendship in cultural and scientific circles of our two countries is of long historic standing and this friendship has flourished unprecedently since the liberation of our two peoples from the oppression of colonialism. May the Chinese and Indian scientists unite more closely and struggle together under the great banner of Pancha Shila to achieve greater success in the common cause of putting science at the service of World peace and human welfare.

13. President, Saxon Academy of Sciences, Leipzig.

Die Saechsische Akademie der Wissenschaften zu Leipzig entbietet der National Academy of Sciences Allahabad zu ihrem silberen Jubilaeum herziliche gruesse und die besten wuensche fuer eine erspriessliche taetigke tim naechsten vierteljahrhundert.

14. Secretary, Smithsonian Institution, Washington.

On the occasion of its Silver Jubilee, the Regents and the Secretary of the Smithsonian Institution send felicitations and best wishes for continued distinguished achievement.

15. Honorary Secretary, Royal Society of Tasmania, Hobart.

We understand that your Academy is about to celebrate its Silver Jubilee. The Council of this Society has asked me to convey the best wishes and congratulations of our Society to your Academy on this occasion.

Through the years the assocation between our two organizations has been of benefit to us and we hope to you and your Council.

16. President, The Royal Society of Canada, Ottawa.

The Royal Society of Canada extends cordial greetings to the National Academy of Sciences, India, on its Silver Jubilee Anniversary.

All branches of Science have made much progress in the last twenty-five years and Societies that have sponsored this development have taken an important place in this advancement. There is still much room for expansion and your Society, through its various activities, can add much to human knowledge.

The Royal Society of Canada, therefore, not only honours you on this Anniversary occasion but, extends to you best wishes for the future.

17. President, Colombian Academy, Bogota.

LA ACADEMIA COLOMBIANA presenta a la The National Academy of Sciences de la India su mas cordial felicitacion en la fecha memorable de sus bodas de plata, y hace votos porque tan benemerita institucion goce largoe anos de vida para bien de la cultura universal.

18. President, Academie Royale des Sciences, des Letters et des Beaux Arts de Belgique, Brussel.

LA "KONINKLIJKE VLAAMSE ACADEMIE VOOR WENTENSCHAPPEN, LETTEREN EN SCHONE KONSTEN VAN BELGIE" S' ASSOCIE DE TOOT COEUR AU JUBILE D'ARGENT DE L' ACADEMIE NATIONALE INDIENNE DES SCIENCES.

ELLE SE REJOOIT DES RESULTATS BRILLANTS DE SES TRAVAUX, QUI SOUS LE STIMULANT D'UNE FECONDE EMULATION, CONTRIBUENT DANS LE CONCERT MONDIAL DES ACADEMIES A REHAUSSER LE RENOM SCIENTIFIQUE DE LA PATRIE INDIENNE.

19. President, Science Council of Japan, Tokyo.

On behalf of the Science Council of Japan, which is the national organization representing all the scientists in Japan, I extend hereby my warmest greetings to the National Academy of Sciences on the occasion of its Silver Jubilee and send my heartiest congratulations on the achievements the Academy has made for the past twenty-five years.

May I also wish for the prosperity of the National Academy of Sciences and for the promotion of future co-operation between the Academy and the Science Council of Japan.

20. President, Royal Academy of Belgium, Bruxelles.

L' ACADEMIE ROYALE, DE BELGIQUE addresse ses plus chaleureuses, felicitations a la NATIONAL ACADEMY OF SCIENCES d' ALLAHABAD a l' occasion de son Jubile di' argent Elle est heureuse de pouvoir lui exprimer ses sentiments d' admiration pour l'oeuvre qu' elle a accomplie. Elle forme le souhait que cette oeuvre se poursuive avec le plus grand succes.

21. Secretary, Hungarian Academy of Sciences, Budapest.

On the occasion of the Silver Jubilee of the National Academy of Sciences in Allahabad, the Hungarian Academy of Sciences extends its warmest congratulations and sincere good wishes for further successes.

Hungarian Scientists watch with great interest and satisfaction the scientific

development in India and sincerely hope that in future personal contact between scientists of both countries will contribute to the furtherance of scientific progress.

22. Director, Maryland Academy of Sciences, Baltimore.

The Maryland Academy of Sciences, which is as far as we know the second oldest institution of its kind in the Western Hemisphere, has heard with interest and pleasure of the celebration of the Silver Anniversary of the National Academy of Sciences in Allahabad.

The people of the world are living in a scientific and industrial age. Institutions such as yours and ours more than ever before have a great opportunity to help our people to live successfully and happily. The path of science is the road of truth and the truth shall make us free.

Please accept our sincere congratulations and best wishes for your success and happiness in the years to come.

23. President, Bavarian Academy of Sciences, Munich.

Die Bayerische Akademie der Wissenschaften entbietet der National Academy of Sciences in Allahabad zum bevorstehenden Silber-Jubilaum die herzlichsten Gluckwunsche. Moge die National Academy of Sciences bluhen und gedeihen, auf das dis wissenschaftliche Zusammenarbeit unserer Akademien reiche Fruchte trage, zum Nutzen der Wissenschaft zum Segen fur die gesamte Menschheit.

24. President, Academia Nazionale dei Lincei, Rome.

L' Accademia Nazionale dei Lincei, elieta di inviare il suo saluto augurale alla Consorella "National Academy of Sciences" in occasione delle manifestazioni che si terranno in Allahabad dal 26 al 29 dicembre 955 per celebrare il venticinquesimo anniversario della sua fondazione.

Questa Instituzione, formula gli auspici di una sempre maggiore e intensa collaborazione culturale tra la nazione Indiana e quella Italiana, ricordando prodondi e sinceri vincoli di amicizia che legano i due Paesi ed e lieta di porgere i piu sinceri e cordiali voti per un sempre piu fecondo sviluppo della attivita scientifica di codesto Onorevole Instituto.

25. President, The Royal Society of Queensland, Brisbane.

Would you please convey to the members of the Indian National Academy of Sciences from the Royal Society of Queensland, our congratulations and greetings on the occasion of your Silver Jubilee, which you are celebrating at Allahabad, and also our very best wishes for the future.

26. President, Royal Society of Victoria, Melbourne.

On the occasion of the Silver Jubilee of the National Academy of Sciences, India, the Royal Society of Victoria sends its congratulations, and best wishes for the future. We are confident that, with the support of your Academy, science will continue to flourish in India for the benefit of humanity.

27. Secretary, The Royal Danish Academy of Sciences and Letters, Copenhagen.

At the occasion of the Silver Jubilee of the National Academy of Sciences at Allahabad the Royal Danish Academy of Sciences and Letters takes great pleasure in presenting our most cordial good wishes for future prosperity and valuable scientific achievements in years to come.

We look forward to strengthening our mutual relations and to making available to Danish scientists whatever publications we shall receive as fruits of your endeavours. We shall go on forwarding to you our own publications, and we greet your Academy at this milestone in the spirit of friendly cooperation between men of science all over the world.

28. Secretary-General, The Royal Netherlands Academy of Sciences, Amsterdam.

It is with great interest that the Royal Netherlands Academy of Sciences has taken notice of the fact that the National Academy of Sciences of India will be celebrating its Silver Jubilee from 26th to 29th December 1955.

The Royal Netherlands Academy rejoices heartily at the 25th. Anniversary of the foundation of your institution and has the honour to tender its most cordial congratulations on this memorable event in the history of Indian science.

The Royal Academy expresses its very best wishes for the prosperity of its sister-institution in India and hopes that it be given to the National Academy of Sciences to continue to extend its work for the benefit of science.

The Royal Netherlands Academy avails itself of this opportunity to send your institution its well-meant greetings.

29. President, Akademie der Wissenschaften, Gottingen.

Die Gottinger Academie der Wissenchafter hat die fortschreitende Forderung der Wissenschaften durch die National Academy of Sciences, India, Allahabad, mit lebhaftem Interesse verfolgt. Sie entibietet zum Silberjubilaum die herzlichsten Gluckwunsche and wunscht fur die zukunft die allerbesten Erfolge bei der wissenschaftlichen Arbeit.

30. President, Royal Society of New South Wales, Sydney.

On behalf of the Council and Members of the Royal Society of New South Wales,

I have much pleasure in conveying our sincere congratulations on the occasion of the Silver Jubilee of the National Academy of Sciences, India, Allahabad, and desire to express good wishes and trust that the session being held to mark the occasion will be a happy and successful one.

31. General Secretary, Royal Society of Edinburgh.

The President and Council have directed me to transmit to you the cordial felicitations of the Royal Society of Edinburgh on the occasion of the Celebration of the Silver Jubilee of the National Academy of Sciences of India, which takes place from December 26-29, 1955.

Recognising the services which the National Academy of Science has rendered, and continues to render, in the maintenance of scholarship and the advance of knowledge, the Royal Society of Edinburgh has much pleasure in sending you its good wishes for the future.

32. President, Akademie der Wissenschaften und der Literatur Braunschweig.

Seitdem der 2. Weltkrieg die gesmate Welt in eine latente Krise gesturzt hat, die ihrem Wesen nach weltanschaulichen charakters ist, hat die Welt durch die Initiative des freien INDIEN neue Hoffnung auf Frieden and Gluck geschopft. Eine so ruhrende politische Rolle konnte INDIEN nicht spielen, wenn es nicht eine uralte eigenstandige kultur hatte und diese pflegte. Hieraus folgt die weltweite Bedeutung der National Academy of Science, der ich zu ihrem Silber-Jubilaeum vom 26. bis 29. Dezember 1955 meine besten Gluckwunsche sende.

33. President, French Association for the Advancement of Science, Paris.

Nous avons ete heureux d' apprendre que l'Academie National des Sciences de l'Inde allait celebrer a la finde l' annee son Jubile d'argent.

A cet te occasion notre Association tient a lui adresser ses bien vives felicitations et ses souhaits pour que votre Academie poursuive sa haute mission scientifique.

Je vous, prie de croire, Cher Monsieur, a mes sentiments les plus distingues.

34. General Secretary, Pakistan Association for the Advancement of Science.

Pakistan Association for the Advancement of Science sends cordial and sincerest good wishes on the occasion of Academy's Silver Jubilee. We hope and pray the Academy will continue its noble task for advancement of science and happiness and prosperity of mankind.

35. President, Solvene Academy of Sciences and Arts, Ljubiljana.

In the name of the Solvene Academy of Sciences and Arts. I offer you congratulations on the attainement of your Jubilee and dare express the conviction that scientific research will ever flourish in the Academy over which you preside.

36. President, Royal Irish Academy, Dublin.

I am requested by the Members of the Council of the Royal Irish Academy to convey their congratulations to the National Academy of Sciences on the completion of 25 years of service to Science.

They wish me to express their sincere hopes for the success of the Silver Jubilee Celebrations, and for a future of ever increasing activity and renown for the National Academy of Sciences.

37. General Secretary, Royal Academy of Exact Physical and Natural Sciences, Madrid.

Esta Academia, en su ultimasesion ha, oida con simpatia su comunicado en el que anuncia la celebracion de sus Bodas de Plata en los dias 26 al 29 del corriente.

La Real Academia de Cinecias Exactas, Fisicas y Naturales de Madrid, se honra enviando a Vds. el testimonio de su simpatia, esperando intensos frutos de colaboracion en la vida cientifica internacional.

38. President, Heidelberger Academie der Wissenschaften.

Die Heidelberger Akademie der Wissenchaften grusst ihre jungere Schwester, The National Academy of Sciences in Allahabad, India, und sendet ihr die herzlichsten Gluckwunsche zu ihrem Silber-Jubilaum. Moge ihr viel Erfolg fur ihre Arbeit beschieden sein zum Segen der Menschheit.

39. President, American Academy of Arts and Sciences, Boston.

The President and Fellows of the American Academy of Arts and Sciences, the second eldest in the United States, sends greetings and congratulations to the National Academy of Sciences, the oldest scientific academy in India, on the occasion of its Silver Jubilee being celebrated December 26-29, 1955.

We have heard from our council member and former President, Harlow Shapley and others, who know of your work, of your exemplary efforts to advance science in India. We wish you continued success in this mission as you enter your second quarter century of activities.

40. President, National Research Council of Egypt.

On behalf of the National Research Council of Egypt I wish to extend to the National Academy of Sciences of India our hearty congratulations on the occasion of its Silver Jubilee. We hope that for many years to come, the Academy will continue to render its good services to the advancement of Science and the furtherance of knowledge.

The strong bonds between your great country and ours coupled with our common

devotion to Science will ensure, in the future, the strengthening of relations between your Academy and our Council.

41. President, The Japan Academy, Tokyo.

The Japan Academy has the honour of congratulating the National Academy of Sciences upon its Silver Jubilee celebrations.

On this festive occasion, our Academy wishes to submit the highest esteem and courtesy to the great contributions you have made to the advancement of science and sincerely hopes your further development and prosperity.

42. President, Afghan Academy, Kabul.

Afghan Academy of Kabul sends the heartfelt greetings on the occasion of Silver Jubilee Celebrations which is to be held in the last week of December 1955 and wishes it grand success.

43. Registrar, University of Oxford.

The University of Oxford sends its greetings and congratulations to the National Academy of Sciences of India on the occasion of its Silver Jubilee, and expresses the confident belief that an illustrious future for Indian science is guranteed by the famous discoveries which Indian scientists have made in the past.

44. Chairman, American Council of Learned Societies, Washington.

The American Council of Learned Societies extends greetings and best wishes for the future to the National Academy of Sciences in Allahabad on the occasion of SILVER JUBILEE. Science and scholarship should know no national boundaries; we are all engaged together in the greatest of human enterprises : to build through increasing knowledge and understanding a better home of all mankind.

45. President, International Association of Universities, Paris.

Knowing that the services which can be brought to human progress by Academies of Science are of the first importance in our troubled age, I have great pleasure in congratulating the National Academy of Sciences of India on its twenty-fifth birthday and in extending the best wishes of the International Association of Universities for its success in the future.

46. Director, International Bureau of Education, Geneva.

The International Bureau of Education heartily congratulates the National Academy of Sciences of India on attaining its Silver Jubilee and sends best wishes for its future development and success in the scientific field.

47. Chancelliere, Academia Nazionale dei Lincei, Roma.

A SEQUITO DELLA LETTERA DEL 23 NOVERMBRE U. S., HO IL PIACERE DI INVIARE A CODESTA ACCADEMIA L'UNITO MESSAGGIO DEL PRESIDENTE DELL 'ACCADEMIA NAZIONALE DEI LINCEI PER LA CELEBRAZIONE DEL 25 ANNIVERSARIO DI CODESTA NATIONAL ACADEMY OF SCIENCES.

48. Rector, Swiss Federal Institute of Technology, Zurich.

In the year of its own centenary, the Swiss Federal Institute of Technology has the honour of offering its congratulations to the National Academy of Sciences of India on the occasion of the Academy's Silver Jubilee. The Swiss Federal Institute of Technology realizes the great importance of your work for the promotion of science in India and knows that in your hopes and ambitions for the future your aims are high.

We welcome this present opportunity of expressing our appreciation of all that you have done and our sincere wishes for continual success in the coming years.

49. Director, Rothamsted Experimental Station, Harpenden.

It is with great pleasure that I send to you, on behalf of the Laws Agricultural Trust and of the staff of Rothamsted Experimental Station, my sincere congratulations and heartiest good wishes on the occasion of your Jubilee in December of this year.

From modest beginnings twenty-five years ago the National Academy of Sciences, India, has grown both in size and prestige, until it is recognised thoughout the world as a most distinguished body of scientists. Concentrating in the early stages, as was natural, on the local problems immediately confronting it, the National Academy has gradually but steadily widened its scope and its interests until at the present day its attention ranges over the entire field of scientific knowledge. In the words of Horace :

Nullius addictus jurare in verba magistri,

Quo me cumque rapid tempestas, deferor hospes.

The growth and expansion of the Academy itself has been mirrored, as is inevitable in its publications. Your earliest journal, the 'Bulletin of the Academy of Sciences, United Provinces of Agra and Oudh', gave place after three years to the 'Proceedings', which within eighteen months assumed the title under which its has come to enjoy a world-wide circulation, so that at the present time every scientific library of any pretensions regards the quaterly 'Proceedings of the National Academy of Sciences, India', for fifteen years now divided into two sections, as an indispensable member of its periodical section.

Stet fortuna Domus ! That this milestone in your development prove a stimulus

towards even greater achievements in the future, is the sincere wish both of my colleagues and myself.

50. Director-General, Unesco, Paris.

I am happy to send you my warmest congratulations on occasion of your Silver Jubilee. By its efforts for development of Science your National Academy, which is oldest Scientific Academy of India, works effectively towards consolidation of peace in the World. Unesco sends you its best wishes for your prosperity.

51. President, International Council of Scientific Unions, New York.

Please accept my sincere personal wishes on the occasion of the Silver Jubilee meeting of the National Academy of Sciences, India, Allahabad. Your Celebration appropriating marks the distinguished contribution of the scientists of India to scientific progress of the world over the past fifty years. Together we can anticipate continued growth of scientific knowledge for the intellectual satisfaction and the international council of the benefit of mankind.

52. Academician Peter Kapitza, Director, Institute of Physical Problems, Moscow.

With warmest feelings I address my most sincere and hearty congratulations to the Academy of Sciences of India on the occasion of its Silver Jubilee.

In our time science has such an important place in public life that no modern state can prosper without its help. But we scientists have not only the greatest satisfaction in putting wonderful tools into the hands of our people, but we also bear the gravest responsibility in restraining evil forces from using modern discoveries for their own selfish interests. This is the real great mission of every Scientific Society. Your National Academy, the bearer of the ancient humanitarian traditions of the great people of India can use its beneficial influence more than any other body.

May I wish your distinguished Society to which I have the great honour to belong many happy returns of the Silver Jubilee.

53. Director, Harvard College Observatory, Massachussetts.

I wish to extend the members and guests of the National Academy of Sciences, India, on this occasion of the Silver Jubilee, the sincere wishes of Harvard scientists for the future of Indian science and the National Academy. I particularly wish to comment concerning the high quality of scientific contributions from India. There are two kinds of scientists in this world, those who lead the way and those who follow. Although both types play important parts in the building of the science, the leaders are those who point the direction of scientific progress. And India has provided an

exceptionally large fraction of leaders, over the whole field of the physical science, in mathematics, in chemistry, in physics, in geophysics, and in astronomy.

We of the Harvard Observatory scientific staff take pleasure in the fact that we have assisted in the formal education of a number of Indian astronomers. We take even great pleasure and pride in their accomplishments. We look forward to increased contact and collaboration with our fellow scientists of India.

54. Prof. W. Brown, Emeritus Professor of Botany, Imperial College of Science and Technology, London.

On the occasion of the Silver Jubilee of the Indian National Academy of Sciences, I have the greatest pleasure in offering you my hearty congratulations on your achievement during the past 25 years and in adding thereto my sincere wish that your affairs will continue to flourish. I send my greetings to all who are assembled at Lucknow University, together with my hopes that the discussions and ceremonies of December 26-29 will be to them a source of the greatest encouragement and pleasure.

55. Prof. Gabriel Betrand, Professor honoraire a la Sorbonne, Member de l' Institut de France.

J' apprends par votre aimable lettre du 15 Ct. que l'Academic Nationale des Sciences de l'Inde m'a elu comme associe honoraire a l'occasion de son Jubile d'Argent.

Je suis tres honore per cette distinction et je vous serai reconnaissant d'etre mon interprete aupres du Bureau de l'Academie pour lui exprimer ma tres vive reconnaisance.

Comme vous en exprimez le desir, je vous envoie ci-joint ma photographie, une biographie succincte et la reproduction d'une conference sur les infiniment petits chimiques ou oligoelements que j'ai faite en 1941 a la seance annulle des 5 Academies de 'Institut de France, alors que j'etais President de l'Academie des Sciences. Le delai que vous m'indiquez est, en effet, trop court et je suis, d'autre part, trop occupe en ce moment pour faire une nouvelle redaction, ce dont je m'excuse, mais le texte que je vous envoie represente bien l'etat de la question des oligoelements dont je m'occupe depuis plus d'umidemisiecle et dont je ne cesse deim'occuper.

En vous reiterant mes remerciements et avec me mellieurs souhaits pour la reussite de ce Jubile, je vous prie d'agreer, Monsieur le Secretaire General, L' assurance de mes sentiments les plus coridiaux.

56. Prof. P. Pascal, Emeritus Professor of General and Inorganic Chemistry, Faculty of Science, University of Paris.

I find myself simultaneously infinitely honoured and touched by the choice of the National Academy of Sciences as Honorary member. This flattering appreciation

which you have kindly accorded for my contribution to science has been a great reward for me specially because I am also celebrating this year 50th Anniversary of my first scientific publication.

57. Prof. Paul Karrer, Rector, University of Zurich.

I wish to express to the National Academy of Sciences, India, Allahabad, my most congratulations on their Silver Jubilee and my best wishes for its further activity.

The National Academy of Sciences plays a great role in the scientific life of your country and has the important task to further all scientific investigation. As a citizen of a small country, Switzerland, which does not dispose of any starting materials, I know how important science is for the development of an industry of high standard. The basis of such an advanced industry is always science. In agreement with this fact, industry did not develop in Switzerland before, the Universities and the Technical High School were founded and had educated several generations of engineers, chemists and other technicians. Let us hope that science will also help to support the economical development of India and that your people and your country will become more and more happy and content.

58. Sir E. John Russell, Formerly Director, Rothamsted Experimental Station, Harpenden, Herts.

The Silver Jubilee of the National Academy of Sciences marks an important stage in the development of science in India. The desire to know something about the mysterious universe in which we live is deeply embedded in all civilised peoples, and it grows as the years go by. It is strengthened by the recognition that a better knowlege of our environment will keep to solve many of the material problems affecting the well being of the people. Science serves equally for use and for discovery.

For many years India has produced leaders in science who have opened up new fields for investigation and added greatly to the sum of human knowledge as each subject develops it became more and more complex ; it is essential therefore that scientists, should have adequate opportunities of meeting for full, unbiassed, and untrammelled discussion of their problems ; also that they should have a medium for the publication of their results so as to keep their colleagues at home and abroad informed of the progress they are making. In the twenty five years of its existence the Academy has admirably fulfilled these functions and has been an unfailing source of strength for the development of Indian Science.

Scientists in many countries will wish the Academy a long and happy continuance of its furitful activities.

59. Prof. Neils Bohr, Director, Institute of Theoretical Physics, Copenhagen.

Send Academy warmest congratulations to Silver Jubilee.

60. Prof. Arne Tiselius, Professor of Biochemistry, University of Uppsala.

On the occasion of the Silver Jubilee of the National Academy of Sciences of India I beg to extend to the Academy my sincerest congratulations and my hope for a successful future. India with its great traditions in science and culture in general and with the remarkable contributions to orginal thought must have a great future in science, to the benefit of your country and of all the peoples of the world. The Academy has a great task in furthering such a development and scientists in all countries follow with sympathy your activities and wish to have the privilege of collaborating with you. I am proud to have been elected an Honorary Member of your Academy and this honour will stimulate my interest in seeking contact with your research workers and your people.

61. Prof. T. G. Halle, State Museum of National History, Stockholm.

On the occasion of the Silver Jubilee of the National Academy of Sciences I am happy to offer my sincere good wishes and whole-heartedly to join the congratulations on the celebration of its first half-century of distinguished acheivements in the service of science.

Closely allied for many years with Indian colleagues in my own branch of study, I have viewed with wonder and admiration the unparalleled rapid advance of palaeobotanical research in India under the leadership of that great man, my regretted friend Bribal Sahni. It is a source of particular satisfaction to me that the jubilee is to be celebrated at Lucknow, the city which holds the lasting monument of his achievements, the Institute of Palaeobotany, and which is now renowned as a common centre of learning among the palaeobotanists of all nations.

It is a tragic consequence of the advance of science that most of us find it increasingly difficult to follow and understand the work that is going on in other branches of reasearch than our own. But in various ways I have received a vivid general impression of the abounding energy and restless activity which appears to be a common characteristic of centres of learning all over India in these days.

Joining with colleagues from other countries in paying tribute to the prominent services which the National Academy has already rendered to the common cause of scientific progress, I wish to add my personal good wishes for the future, confident that the years to come will bring continued and increasing success and prosperity.

62. Prof. A. H. Compton, Chancellor, Washington University.

May I congratulate the National Academy of Sciences, India on its twenty-five years of service to the growth of science. Here is a language that crosses national boundaries. We in the United States welcome the cooperation of our Indian colleagues in the finding of new and useful knowledge. We are pleased to share with you thus in promoting man's welfare.

63. Prof. Arnold Heim, Professor of Geology, Zurich.

It is a great pleasure to hear that your Academy is celebrating the Silver Jubilee, since I am still attached to the scientific progress of your great country.

It was in 1935 when I had the first chance to visit India. Then, in 1936, together with my young friend Dr. A. Gansser, I conducted the first Swiss Himalaya Expedition, crossing several times the great Himalaya ranges until Transhimalaya, with the purpose of studying the geological structure. The result was to establish the greatest thrust folds of our globe.

In 1949, I visited Nepal, and, thanks to the kind help of Prime Minister Nehru, together with my excellent Indian friends and colleagues Wadia and Sahni, I made first flying observations across western Nepal Himalaya. It was after this marvellous experience that, on October 19th, 1949, I followed the invitation of your Academy at Allahabad to present a lecture on the great structure of the Himalaya and to show my cinefilm. Finally in 1952, I visited the old continental regions of Southern India.

These wonderful experiences remain amongst the most fruitful ones of all my expeditions in foreign continents.

64. Prof. J. N. Couch, Keenan Professor of Botany, University of North Carolina, Chapel Hill.

I am pleased to send greetings and best wishes to the Officers and Members of the National Academy of Sciences of India on the occasion of its Silver Jubilee. I wish I could be with you to enjoy the fellowship and intellectual stimulation of these meetings and hope that at some future time I can attend.

65. Sir Gay A. K. Marshall, Formerly Director, Commonwealth Institute of Entomology, London.

As one who was born at Amritsar, Punjab, 84 years ago I have long taken a sympathetic interest in the development of scientific work in India, and a perusal of the publications of your Academy shows how important and varied have been the contributions made by the Fellows of your Academy to this subject.

India offers a vast and fascinating field for research in many sciences, and I feel sure that your organisation will play an important part in advancing the boundaries of scientific knowledge.

66. Prof. E. C. Titchmarsh, Savilian Professor of Geometry, University of Oxford.

I wish all success to the Silver Jubilee celebrations of the National Academy of Sciences of India which is distinguished by the world famous discoveries of Indian scientists.

67. Pandit Jawaharlal Nehru, Prime Minister of India.

I send you my good wishes.

68. Dr. S. Radhakrishanan, Vice-President of India.

I send my best wishes for the success of the function.

69. Secretary to the Governor of Uttar Pradesh.

Sri Rajyapal wishes the Session success and hopes that the Academy will continue to promote the development of Science for the betterment and prosperity of humanity.

70. Sri Sri Prakasa, Governor of Madras.

I earnestly hope your conference will be able to take decision of helpful nature so that world peace and human prosperity may be assured, and Science continue to be of true service to man, and all fears from its latest manifestations, eliminated. I send my best wishes for the success of your session.

71. Prof. P. S. Macmohan, First General Secretary of the National Academy of Sciences.

My heartiest congratulations to the National Academy of Sciences, on the attainment of its Silver Jubilee this month.

I am happy to have had the honour of being its first General Secretary and should have wished to have continued my association with its activities, but unfortunately circumstances have decided otherwise.

It is particularly gratifying to me that the celebration is taking place in Lucknow where I passed so many years in the Canning College and in the Lucknow University.

When I first arrived in Lucknow 45 years, ago, the cultivation of science was practically non-existent. There were neither laboratories, work-shops nor libraries ; and what is worse, there was no consciousness either among the authorities, nor among the general public, of the vital part that a scientific knowledge plays in modern civilisation.

It was a feeling of local frustration which led me in 1912 to put forth proposals for an all-India Science Congress ; and I am happy to think it has been a success, not only in itself, but also in giving rise to healthy offspring, of which the National Academy is a notable example.

Since the times I am sepaking of, it is needless to point out that scientific achievement has reached unparallel heights in the history of mankind ; among whose generality, ignorance, apathy and indifference has now farforce given place to a lovely desire for a share in the benefits about science can bestow, among all nations. It is indeed possible that we are on the verge of still more startling advances in our knowledge and

control of the physical forces of nature, which may entirely transform the social, political and economic face of the world.

There are now dazzling prospects before scientists undreamt of a few years ago ; (I) the replacement of the present sources of energy coal and oil (which favour some countries to the detriment of others), by tapping the measureless energy locked up in matter and (II) by the photo-synthesis of food-stuffs hitherto carried out solely through the agency of living plants.

There is no country in the world more urgently in need of these things, than India, with its vast and pressing problems of unemployment and undernourishment among large section of the population.

Although the immediate attainment of such objects may appear ambitious so far as University laboratories are concerned, it is nevertheless of the highest importance that training in the methods of research should be imparted which might bear fruit

I conceive that an institution like the National Academy will have a more important part there even in the future, in encouraging research by the publication of original papers from students ; and it will also have to educate the public to form a just appreciation of what science has to give ; that these gifts may be turned to the good of mankind and not to its self destruction.

I wish it a long and distinguished future.

72. President, National Institute of Sciences of India.

Twenty-five year's progress in the life of a scientific Academy is an important milestone, particularly in India. Now that we have achieved freedom, a great onus rests on an Academy such as yours to stimulate both fundamental and applied research in our country. May you continue to advance steadily along the path chalked out by you and help to secure an important place for India on the scientific map of the world.

73. Dr. D. N. Wadia, Geological Adviser to the Department of Atomic Energy Government of India.

Please accept my sincere congratulations on the completion of the first 25 years by the Academy . A great deal of useful path-finding work has been done during this difficult period and all connected with the executive are entitled to our warm thanks.

I wish the National Academy of Sciences of India continued success and that in the coming years it may build on the foundations so well laid a truly great scientific institution.

SILVER JUBILEE SESSION AT UNIVERSITY OF LUCKNOW

26th to 28th December 1955

Prof. M N. Saha, Founder of the Academy, addressing the opening session

Prof. S. Ghosh presenting the Secretaries' Report

ADDRESS BY THE CHAIRMAN OF THE RECEPTION COMMITTEE

By

DR. RADHAKAMAL MUKERJEE, M.A., PH.D.

Vice-Chancellor, University of Lucknow

I deem it an honour and privilege to offer a most hearty welcome to this Silver Jubilee Session of the National Academy of Sciences. Your delibera tions here will no doubt be a source of inspiration to the various Departments of Science in our University and stimulate scientific thought in general. All through the epochs the endless discoveries of science continuously change the world-picture envisaged by man. But at no time has the world-picture been so radically altered nor has become so incompatible both with the philosophical tradition of humanity and its peace and well-beinf as in this age. Modern Western thought and its division for the interpretation of the picture of the universe have been revolutionised within a single generation

It is, however, hardly recognised that the sweep and majesty of contemporary cosmology and cosmography in the West are so much akin to the traditional world-picture of the Orient. Long before Copernicus man in the Orient lost his cosmic importance which he still arrogates to himself in the Occident. Three things stand out as components of the world-picture provided by the theory and philosophy of contemporary Occidental science that are largely in accord with Oriental philosophical traditions. First, Astronomy and Paysics take us away from the limitations of space, as Geology, Biology, History, Anthropology and Sociology take us away from the limitations of time. Man, therefore, appears as a speck in the unbounded universe as a drop in the pulsating ocean of time. Such a conception gives man the feeling that there is something entirely trivial or accidental about his existence in the vast space-time continuum. The emancipation of man from the rigid boundaries of time and space endenger abstract, generalized and detached discourse which is the essence of the scientific outlook. Thus proceed on the one hand, the imperative of the impersonalization and universalization of his thought, and on the other, the feeling of his fallibility or absence of certitude about ideas and concepts. The entire trend of adventure of human thought is against dogmatism and absolutism. Today there is a recrudescence of primitivisim and intolerance in modern social thinking as we regard certain ideologies

and social and economic systems as sacrosanct, dividing mankind into belligerant camps for a global struggle. The philosophy of history finds milestones of mankind's advance marked not by fanaticism and bigotry that come to possess peoples, drive them to violence and fade away in history, but by intellectual synthesis, moral and religious humansim and the impartiality and universality of human personality.

Second, a significant trend of modern interpretation of the world-picture is represented by the notions of simplicity and unity. The supreme task of the modern physicist is the discovery of the most general elementary laws from which the world-picture can be deducted logically. But there is no logical way to the discovery of these elemental laws. Einstein observes : "There is only the way of intuition which is helped by a feeling for the order lying behind the appearance and this Einfuehling is developed by experience. In every important advance the physicist finds that the fundamental laws are simplified more and more as experimental research advances. He is astonished to notice how sublime order emerges from what appeared to be chaos. And this cannot be traced back to the workings of his own mind but is due to a quality that is inherent in the world of operation. Leibniz well expressed this quality by calling it "a pre-established harmony".

More and more it is recognised by the outstanding scientists of the age that artistic and religious insight represents the source and guide of modern scientific discovery. Einstein observes : "The cosmic religious experience is the strongest and noblest mainspring of scientific research". According to Planck the stage at which theoretical physics has now arrived is beyond the average human faculties, even beyond the faculties of the great discoverers themselves. Thus the greater sensitiveness and refinement of the scientific apparatuses and instruments will have to be accompanied by the greater keenness of the introspective, symbolising mind. The human mind in exploring the macrocosm comes at last to a "final", featureless unity of space-time, mass-energy, matter-field, an ultimate, undiversfied and eternal ground," beyond which it finds itself unable to progress, and of which it is itself an ephemeral conformation. Thus man's understanding of his own mind's qualities of perceiving the universe, of reasoning, of transcending himself and perceiving himself in the act of perception is, in the final analysis, crucial for the world-picture. The world-picture cannot be formed out of the things and appearances of the world, but out of something beyond itself which his consciousness identifies with his real rather than immediate self. This is in entire accord with the traditional Indian metaphysical emphasis of the dialetic of self-valuation and self-transcendence.

Thirdly, as science develops impersonal thinking so does it foster impersonal feelings and aspirations. This side of human knowledge that is also an essential ingredient of the modern world-picture has developed much more in the East than in the West. The philosophical tradition in India posits the identity of finite man with Brahman

which is fullness and totality. Thus universal love, compassion and non-violence are grounded in metaphysics. The schools of the Vedanta that have shaped Indian thought and life for about two millennia and a half stress the realisation of Brahman as an obligation on the basis of the unity of man with all fellowmen and sentient creatures. Charity, benevolence and compassion not only have a metaphysical basis, in India, but these directly lead to the ultimate reality. Morality and Truth are but two facets of the realisation of the true nature of man.

No doubt mankind's moral and social progress is stimulated and inspired by impersonal and generalised feelings and emotions. Ethics, like science, should be general and should be emancipated, as far as this is humanly possible, from the tyranny of the here and now, should have its roots in sympathetic imagination. "Sympathy", Bertrand Russell observes, "is the universalizing force in ethics; I mean sympathy as an emotion, not as a theoretical principle. Where there is limitation of sympathy there is a corresponding limitation in the conception of the good; the good becomes something to be enjoyed only by the magnanimous man, or only by the super-man, or the Aryan, or the proletarian or the Christadelphian. All these are cat-and-mouse ethics". Western ethics is still largely governed by the Kantian notion of equity and justice rather than by those of love and sharing, so much stressed in Oriental and Christian morality. In post-Kantian thought in the West, the Hegelian, Marxian and totalitarian ethics have eclipsed the freedom and self-realisation of the Kantian ethical individual, and subordinated spiritual values to a rigid moral, cultural and economic determinism ; while the Kantian delimitation of the autonomous spheres of religion and ethics still holds good in contemporary Western thought. In India the ethics founded on the metaphysics of the indwelling of God in man fosters infinite charity and compassion for all sentient beings, and is equilitarian, buoyant and dynamic. In her non-theistic ethical systems it is introspection that establishes an inward continuity of self and the universe as a whole, including more than man, and generates reverence for man, absolutely every common man.

A true world-picture cannot be shaped by the development of the impersonal and universal thought of science and philosophy alone. Religion, morality, art and literature are other and may be even more important means of understanding and interpretation of the universe and the expression of human nature. The world picture must accordingly be integrated out of the symbolical worlds built by both the sciences and the humanities. The intellectual history of the West under the impact of Protestantism, industrialization and mechanization has been gripped today by a profound cleavage between the philosophy of science and the philosophy of value, which Kant introduced and stereotyped and which has completely warped her thought system. If the value of human knowledge is to be sought not merely in relation to speculation

but also to a proper understanding and appreciation of the ends of man's life and destiny, it is essential that he cultivates expansive feelings and aspirations, freed from self-reference and from his limited social context, even as he develops the impersonal thinking of science, and this should equally proceed from his metaphysical outlook. The Buddhist, the Vedantic and the Chinese philosophies, in so far as these have identified wisdom with the erasement of the boundaries of self, and fusion of self with the not-self, the society or the universe, have succeeded in presenting world-picture grounded in the universalising and impersonalising of both intellect and emotion that is certainly conducive to the promotion of the world community of tomorrow.

The third quarter of the twentieth century will probably witness mankind's most far-reaching, intellectual and psychological changes if the human species is to survive. The atom bomb is too dangerous and devastating a weapon in the hands of man to tolerate any more international friction and war. Probably in this decade the atom or the hydrogen bomb will be no secret nor monopoly. Every power-station in the world will be a potential bomb factory, and no international inspection will able to restrict nuclear splitting to peaceful and constructive purposes. Thus the atom will abolish the individual sovereign state by simply focussing mankind's fateful choice between the world community and destruction. Abolition of war will mitigate or eliminate war's twin sisters, class exploitation and individual aggressiveness. The unprecedented increase of wealth, leisure and opportunities of adventure in the atomic age will surely call for a socialistic distribution of income and property and social security, collectivisation of agriculture and industry, and above all an overhaul of the educational system, eliciting a new co-operativeness and team spirit in practical and intellectual enterprise.

Mankind, if it has to outlive its crisis in the atomic age will have to be educated in a new sense of social equality and fellowship. An extension of the boundaries of the mind, through intution, yoga or mysticism—whatever it may be called—alone can overcome the unprecedented crisis in man's history brought about by the sudden accession to his power by modern science and the lop-sided development of his intellect. The next step in man's evolutionary advance will, indeed, be represented by his direct access to another's mind, without which he will be thurst back to his simian origins as the remaining half-century becomes atomic. Such is at once the dismal and bright outlook that the development of contemporary science presents for human life and destiny.

SILVER JUBILEE SESSION
AT
UNIVERSITY OF LUCKNOW

26th to 28th December 1955

Dr. S. P. Mitra, Assistant Professor of Chemistry, University of Allahabad receiving U. P. Government Education Minister's Gold Medal for 1955 for the best papers publised in the Proceedings of the Academy (1950-55) in Chemistry and Technology from Dr. Sampurnanand, Chief Minister of Uttar Pradesh.

SECRETARIES' REPORT

Presented at the Silver Jubilee Session of the National Academy of Sciences, India held on Monday, 26th of December 1955, at the A. P. Sen Hall of the University of Lucknow Lucknow. U. P.

By PROFESSOR S. GHOSH, D. Sc., F. R. I. C., F. N. I., F. N. A. Sc.

We have the honour to submit the following report on the working of the National Academy of Sciences, India, during the period from January 1, 1955 to December 1955.

OBITUARIES

During the period the Academy has sustained great loss due to the sad demise of the following distinguished Fellows and well-wishers of the Academy :—

(1) Dr. S. S. Bhatnagar, D. Sc., F. R. S., F. N. I., F. N. A. Sc.,
(2) Sri J. P. Srivastava, former Education Minister of the Uttar Pradesh Government.
(3) Dr. S. Datta, D. Sc., D. I. C., F. N. I., F. N. A. Sc., former Director of Public Instruction, West Bengal.
(4) Dr. H. L. Chibber, D. Sc., F. N. I., F. N. A. Sc., Head of the Department of Geography, Hindu University, Banaras.
(5) Dr. Jagdeshwari Dayal, D. Sc., Department of Zoology, Lucknow University.

MEMBERS

The Academy has now on its rolls 265 members, of whom 150 are Fellows.

FELLOWS

We have great pleasure in announcing the election of the following as new Fellows of the Academy during this year :—

(1) Mrs. Savitri Sahni, M. Sc., Director, Birbal Sahni Institute of Palaeobotany, University Road, Lucknow.
(2) Professor W. D. West, Sc. D., F. N. I., Head of the Department of Geology, Univeristy of Saugar, Sagar (M. P.).

(3) Lt. Col. G. H. Gayre, PH.D., D. Sc., Head of the Department of Anthropo-Geography, University of Saugar, Sagar (M. P.).
(4) Dr. S. H. Zaheer, PH. D., Director, Central Laboratories for Scientific and Industrial Research, Hyderabad.
(5) Prof. G. H. Dungan, University of Illinois, Urbana, Illinois, U. S. A.
(6) Dr. M. L. Misra, D. Sc., Head of the Department of Mathematics, University of Saugar, Sagar, M. P.
(7) Dr. D. P. Banerjee, D. Sc., Head of the Department of Mathematics, Meerut College, Meerut, U. P.
(8) Dr. M. K. Mukerjee, M. Sc., PHD., Physical Chemist, Jute Agricultural Research Institute, Barrackpore (West Bengal).
(9) Dr. S. K. Mukherji, M. Sc., D. PHIL., Agricultural Chemist to the Government of West Bengal, State Agricultural Research Institute, Tollygunge, Calcutta-40. (W.B.).
(10) Dr. K. R. Surange, PH. D., Birbal Sahni Institue of Palaeobotany, University Road, Lucknow.
(11) Prof. S. S. Doosaj, M. Sc., Head of the Chemistry Department, Durbar College, Rewa. (U.P.).
(12) Dr. Arabinda Roy, M. Sc., PH. D., Professor of Biochemistry, U.P. College of Veterinary Science, Mathura (U. P.).
(13) Dr. C. L. Dhawan, M. Sc., PH. D., Physical Chemist, Irrigation and Power Research Institute, Amritsar (East Punjab).
(14) Dr. B. B. L. Saxena, M. Sc., D. PHIL., Lecturer in Chemistry, University of Allahabad, Allahabad.
(15) Dr. Har Swarup, M. Sc., PH. D., F. Z. S., Lecturer in Zoology, University of Saugar, Sagar (M. P.).
(16) Dr. S. B. Saxena, PH. D., Lecturer in Botany, University of Saugar, Sagar, (M. P.).
(17) Dr. S. N. Banerji, M. Sc., D. PHIL., Reader in Chemistry, University of Saugar, Sagar, (M. P.).
(18) Dr. T. V. Desikachary, M. Sc., PH. D., Lecturer in Botany, University of Saugar, Sagar (M. P.).
(19) Dr. Ram Gopal Chatterjie, Department of Physics, Indian Institute of Technology, Kharagpur.
(20) Shri Ved Prakash, M. Sc., Head of the Department of Chemistry, Coronation Hindu Degree College, Moradabad, U. P.

Thirty eminent scientists from different countries are on our roll as Honorary Fellows.

ORDINARY MEMBERS

We welcome the following as the new Ordinary Members of the Academy who have been elected during the year under review :—

(1) Mrs. Savitri Sahni, Director, Birbal Sahni Institute of Palaeobotany, University Road, Lucknow.
(2) Prof. G. H. Dungan, University of Illinois, Illinois, U. S. A.
(3) Dr. M. K. Mukherji, M. Sc., PH. D., Jute Agricultural Research Institute, Barrackpore, West Bengal.
(4) Dr. S. K. Mukerji, M. Sc., D. PHIL., Agricultural Chemist, West Bengal, 230, Netaji Subhas Road, Calcutta-40.
(5) Dr. Arabinda Roy, M. Sc., PH. D. (London), Professor of Physiology and Biochemistry, U. P., College of Veterinary Science, Mathura.
(6) Dr. T. V. Desikachary, M. Sc., PH. D., Botany Department, University of Saugar, Sagar, (M. P.).
(7) Dr. Balai Chand Pathak, M. Sc., D. PHIL., Lecturer in Chemistry, Saugar University, Sagar, M. P.
(8) Shri Newton Ram, B. Sc., (Hons.), M. Sc., Lecturer in Chemistry, Agra College, Agra.
(9) Dr. Satya Pal Singh Teotia, B. Sc., (AG.), M. Sc., PH.D. (U. S. A.), Soil Survey and Planning Officer, Soil Conservation Department, Damodar Valley Corporation, Hazaribagh, Bihar.
(10) Shri Shiva Sagar Singh, M. Sc., Assoc. I. A. R. I., Agricultural Liaison Officer. Rewa, V. P.
(11) Dr. G. S. Rao, PH. D., Lecturer in Chemistry, University of Saugar, Sagar M. P.
(12) Dr. Krishna Rajaram Surange, PH. D. (Cantab.), Birbal Sahni Institute of Palaeobotany, University Road, Lucknow.
(13) Shri Rajendra Nath Lakhanpal, Birbal Sahni Institute of Palaeobotany, University Road, Lucknow.
(14) Shri Chandra Prakash Varma, Birbal Sahni Institute of Palaeobotany, University Road, Lucknow.
(15) Dr. S. B. Saksena, Department of Botany, University of Saugar, Sagar (M. P.).
(16) Dr. W. D. West, Sc. D. (Cantab.), F. N. I., Professor and Head of the Department of Geology, University of Saugar, Sagar.
(17) Lt. Col. G. H. Gayre, PH. D., D. Sc., Head of the Department of Anthropo-Geography, University of Saugar, Sagar, M. P.

(18) Dr. J. C. Basu, PH. D. (London), D. I. C., Lecturer in Zoology, University of Saugar, Sagar, M. P.

(19) Dr. D. P. Jatar, PH. D., Lecturer in Physics, University of Saugar, Sagar, M. P.

(20) Dr. S. N. Banerji, D. PHIL., Reader in Chemistry, University of Saugar, Sagar, M. P.

(21) Shri M. P. Shrivastava, M. Sc. (London), Reader in Physics, University of Saugar, Sagar, M. P.

(22) Dr. K. C. Verma, M. Sc., PH. D. (Washington), Lecturer in Chemistry, University of Saugar, Sagar, M. P.

(23) Dr. Har Swarup, PH. D., Lecturer in Zoology, University of Saugar, Sagar, M. P.

(24) Dr. M. S. Manhas, D. PHIL., Lecturer in Chemistry, University of Saugar, Sagar, M .P.

(25) Shri A. V. Mahajani, M. Sc., Lecturer in Chemistry, University of Saugar, Sagar, M. P.

(26) Shri H. N. Shrivastava, B. Sc. (Hons.), M. Sc., Lecturer in Chemistry, University of Saugar, Sagar, M. P.

(27) Shri C. S. Chouhan, B. Sc., A. H. B. T. I., Lecturer in Chemistry, University of Saugar, Sagar, M. P.

(28) Shri R. L. Nikore, M. Pharm., Lecturer in Chemistry, University of Saugar, Sagar, M. P.

(29) Shri P. N. Awasthi, M. Sc., Lecturer in Chemistry, University of Saugar, Sagar (M. P.).

(30) Shri C. N. Kachru, M. Sc., Lecturer in Chemistry, University of Saugar, Sagar (M. P.).

(31) Shri Y. G. Kher, M. Sc., Lecturer in Chemistry, University of Saugar, Sagar, M.P.

(32) Shri O. N. Tripathi, M. Sc., Senior Research Scholar, Deptt. of Chemistry, University of Saugar, Sagar, (M. P.).

(33) Shri S. P. Banerji, M. Sc., Government of India Senior Research Scholar, Deptt. of Chemistry, University of Saugar, Sagar, M.P.

(34) Shri G. C. Jain, M. Sc., Government of India Junior Research Scholar, Department of Chemistry, University of Saugar, Sagar, M.P.

(35) Dr. D. P. Banerji, D. Sc., Head of the Deptt. of Mathematics, Meerut College, Meerut.

(36) Dr. C. L. Dhawan, PH.D., Physical Chemist, Irrigation & Power Research Institute, Punjab, Amritsar.

(37) Shri A. K Dhar, M. Sc., (Ag.)Agricultural Officer, Carew & Co., Ltd., Darsana (East Pakistan.)

(38) Dr. M. L. Misra, D. Sc., Head of the Deptt. of Mathematics, University of Saugar, Sagar (M. P.).

(39) Dr. S. P. Raychaudhuri, PH. D., (London), D. Sc., (Cal. & Lond.) F. R. I. C., F. N. I., Head of the Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, New Delhi.

(40) Dr. C. Dakshinamurti, D. Sc., PH. D., F. INST. P., Experimental Physicist, Indian Agricultural Research Institute, New Delhi.

(41) Dr. S. M. Das, D. Sc., F. Z. S., F. A. Z., F. Z. S. I., Reader in Zoology, University of Lucknow, Lucknow.

(42) Dr. S. B. Sinha, M. Sc., D. PHIL., Chief Chemist, Agricu tural Research Institute, Gwalior, M. P.

(43) Shri Dinesh Chandra Bhardwaj, Birbal Sahni Institute of Palaeobotany, University Road, Lucknow.

(44) Shri Vishnu Mitra, Bribanl Sahni Institute of Palaeobotany, University Road, Lucknow.

(45) Dr. S. C. Ghosh, M. Sc., D. PHIL., Lecturer in Zoology, University of Allahabad, Allahabad.

(46) Dr. Sarju Prasad, M. A., M. Sc., D. Sc., Reader in Chemistry, Hindu University, Banaras.

(47) Dr. K. K. Baslas, Professor of Chemistry, K. N. Government College, Gyanpur, Banaras.

(48) Shri Prem Behari Mathur, M. Sc., Deptt. of Chemistry Allahabad University, Allahabad.

(49) Shri Madhuri Mohan Rai, M. Sc., Sheila Dhar Institute of Soil Science, Allahabad, University.

(50) Shri Maya Shankar Lal, M. Sc., Sheila Dhar Institute of Soil Science, Allahabad University, Allahabad.

MEETINGS

During the year under report, five meetings of the Council, one emergent Meeting of the Council, four meetings of the Sub-Committee of the Council, four Ordinary Meetings (including the Annual Meeting), and two Fellows Meetings were held.

ANNUAL SESSION

The Twenty-Fourth Annual Meeting of the National Academy of Sciences, India, was held on December 27, and 28, 1954, at Saugar University, on the inivitation by the Vice-Chancellor of the University. We are grateful to the Hon'ble Pandit Ravi

Shankar Shukla, the Chief Minister of Madhya Pradesh, for presiding over the session. Six popular lectures on the different scientific subjects were delivered on the occasion. A Symposium on "Recent Trends in Soil Research" was held under the chairmanship of Professor N. R. Dhar, D. Sc., F. R. I. C., F. N. I., and 120 papers were received from countries like England, Germany, France, Japan, U. S. A., Israel, Indonesia etc., and were discussed by authors and other scientists coming over from different parts of the country. In addition to the above popular lectures on scientific topic and the Symposium, fifty five papers in Physical Sciences and thirty papers in Biological Sciences were also received and discussed. The section of Physical Sciences was presided over by Professor P. S. Gill, and the section of Biological Sciences by Dr. R. K. Saksena.

We offer our cordial thanks to Dr. R. P. Tripathi, the Vice-Chancellor of Saugar University and the Chairman of the Reception Committee, the two local Secretaries Dr. A. K. Bhattachrya, and Dr. D. S. Shrivastava, and the staff of the Saugar University, for the excellent arrangements made for the success of the session. More than seventy five delegates from different parts of the country, England and America attended the session.

COUNCIL, ITS OFFICE-BEARERS AND OTHER MEMBERS

The following were elected for the year 1955 :—

President

(1) Professor P. L. Srivastava, M. A., D. PHIL. (OXON), F. N. I., F. N. A. Sc.

Vice-Presidents

(2) Professor A. C. Banerji, M. A. (CANTAB), M. Sc. (CAL.), F. R. A. S. (LONDON) I. E. S., (RETD.) F. N. I., F. N. A. Sc.,
(3) Professor P. S. Gill, M. S., PH. D. (CHICAGO), F. A. P. S., F. N. I., F. N. A. Sc.

Honorary Treasurer

(4) Dr. R. K. Saksena, D. Sc. (PARIS), F. N. I., F. N. A. Sc.

Foreign Secretary

(5) Professor Shri Ranjan, M. Sc. (CANTAB.), D. Sc. (STATE-FRANCE), F. N. I. F. N. A. Sc.

General Secretaries

(6) Professor S. Ghosh, D. Sc., F. R. I. C., F. N. I., F. N. A. Sc.
(7) Shri S. Basu, M. Sc., F. N. I., F. N. A. Sc.

Members

(8) Professor M. N. Saha, D. Sc., F. R. S., F. N. I., F. N. A. Sc.
(9) Professor N. R. Dhar, D. Sc. (LONDON & PARIS), F. R. I. C., I. E. S. (RETD.), F. N. I., F. N. A. Sc.
(10) Dr. J. C. Ghosh, D. Sc., F. A. S., F. N. I., F. N. A. Sc.
(11) Professor H. R. Mehra, M. Sc., PH. D. (CANTAB.), F. N. I., F. N. A. Sc.
(12) Dr. A. K. Bhattacharya, D. Sc., F. R. I. C., F. N. A. Sc.
(13) Dr. D. N. Wadia, M. A., D. Sc. (HON.), F. G. S., F. N. A. Sc.
(14) Professor Y. Bharadwaja, M. Sc., PH. D. (LONDON), F. L. S., F. N. I., F. N. A. Sc.
(15) Professor S. N. Das Gupta, PH. D., D. Sc., D. I. C., F. A. Sc., F. N. A. Sc.
(16) Professor K. Banerji, D. Sc., F. N. I., F. N. A. Sc.

FINANCE

The Financial position of the Academy is shown in the Financial Statement for the year 1954-55, ending March 31, 1955, appended in the Report.

We express our deep sense of gratefulness to.

(1) The University of Allahabad for giving the annual grant of Rs.1,000 for the year 1954-55.
(2) the Council of the National Institute of Sciences of India for its annual recurring donation of Rs.1,000 for 1953-54, and Rs.1,000 for the year 1954-55.
(3) the Hon'ble Minister for Education, Uttar Pradesh Government for Rs. 6,000 for the annual recurring grant for 1954-55, and,
(4) the Government of India, Ministry of Natural Resources and Scientific Research, for a non-recurring grant of Rs. 4,000 towards the cost of meeting the expenses of the arrears of the publications.

These grants are inadequate for our needs of this year, beacause of the fact that eleven parts of the Proceeding for the year 1954 and one Special Symposium on "Recent Trends in Soil Research" are to be published for which approximately we require a minimum sum of Rs. 16,000.

PUBLICATIONS

The Proceedings of the Academy continued to obtain marked recognition in India and abroad. The publications have been frequently quoted and requisition are always made from all over the world for the publication, and reprints of valuable papers. The Proceedings of the Academy are published in two Series :—A and B. Series A deals

with Physical Sciences and Series B with Biological Sciences. From January 195 to December 1955, the Academy has been able to publish 7 parts of its arrears o Series A and Series B.

EXCHANGE LIST

There are 188 Foreign Journals on our Exchange List. Every year we have t agree to the exchange of our Proceedings for foreign journals, but we are unable t enlarge our exchange list largely due to the paucity of funds and consequently we can not expand our library with respect to foreign publications received in exchange.

LIBRARY

There is plenty of scope for the improvement of the Library but funds are lackin The Academy has been approaching both the Union and the State Governments fo financial help since 1948 by submission of annual applications for consideration.

AWARD OF THE UTTAR PRADESH GOVERNMENT EDUCATION MINISTER'S GOLD MEDAL

The Annual session for the year 1932-33, was held at Allahabad, and was pres ded over by Sri J. P. Srivastava, M.Sc. (Tech.) the then Minister for Education, Un ted Provinces of Agra and Oudh. At this session he started a convention of awardi a Gold Medal by the Education Minister of U. P. for the best research work publishe in the Proceedings in different branches of science. This year the medal has been awar ed for Chemistry and Technology, and we have great pleasure to announce that t Council on the unanimous recommendation of the judges has decided to award th medal to Dr. S. P. Mitra, M. Sc., D. PHIL., F. N. A. Sc., Lecturer in Chemistry, Un versity of Allahabad, for his papers on Chemistry and Technology published in t Proceedings of the Academy.

MADHYA PRADESH BRANCH AT THE UNIVERSITY OF SAUGAR

Many of the Fellows and the Members of the Academy from Saugor, Madh Pradesh, took keen initiative for opening a branch at Saugor. The Council consider it and in order to develop and advance science in all its branches decided to open th branch at Sagar at its meeting on December 18, 1954. The Council framed Rul under the provisions of the powers conferred upon it under the existing provisions of t Regulations of the Academy, which has been finally confirmed by the General Bo of the Academy. We have great pleasure to report that the Madhya Pradesh Gover ment sanctioned a non-recurring grant of Rs. 3,000 which has been spent on the init expenditure of the Branch. A recurring grant of Rs.2,500 has also been granted

the same Government and the Council has decided to spend this amount for esta- blishment of a branch office at Saugor and to meet partial expenses towards the publi- cations of papers etc. We have to express our deep sense of gratefulness to Madhya Pradesh Government for providing us the funds which has enabled us to start this branch.

GENERAL REMARKS

On the 4th of December 1930, with nineteen Foundation Fellows from different parts of the Province of Agra and Oudh, the Academy was registered under the Societies Registration Act, XXI of 1860. Professor M. N. Saha, D. Sc., F. R. S., who took great initiative in starting this Academy, became the Founder-President. The membership of the Academy was thrown open not only to the scientists but also to those who took keen interest in the development of science and as many as 87 members were on the roll on the 31st October 1931. The Academy was housed in a small room of the Muir Central College Block of the Allahabad University and the Library in the Department of Physics and this continued to be so till 1953, when the Academy constructed its own building of which the foundation was laid by Dr. Sampurnanand on the 22nd. January 1953, and the formal opening ceremony was performed by Shri Chandra Bhal, President, Legislative Council, Uttar Pradesh, on November 21, 1954. We have to mention here that the building costing over Rs. 50,000 (including the cost of the land estimated to be Rs.15,000 and donated by Professor N. R. Dhar), has been built completely from public donations and we take this opportunity to thank all the donors for providing the Academy its own house. We have also to convey our thanks to the authorities of the Allahabad University for providing us this accommodation for 23 years. In 1931 this State sanctioned a non-recurring grant of Rs. 4,000 which was raised to Rs. 6,000 in the year 1950-51. We also get Rs. 1,000 annually from the National Institutes of Sciences of India and Rs. 1,000 annually from the University of Allahabad. The Madhya Pradesh Government has given a non-recurring grant of Rs. 2,500 annually for establishing our branch at Saugor University. The Academy is thankful to all those concerned who have given us this recurring financial help.

The inaugural function of the Academy was held on March 1, 1932. At this in- augural function the messages of goodwill from many eminent scientists of the world were received and late Professor Einstein wrote, "May you by your efforts, not only further the spiritual and economic development of your countries but also clear up deeper questions which nature, ever full of riddle is presenting to us".

The rules and regulations of the Academy are liberal and democratic and it is possible for every scientific worker and lover of science to join the Academy as its member. It is our proud privilege to have on the list of our Honorary Fellows such persons as late Pandit Madan Mohan Malviya, late Sri J. P. Srivastava, Pandit

Jawahar Lal Nehru, Pandit Govind Ballabh Pant and Dr. Sampurnanand, who have been and and are our great national leaders and have also contributed greatly to the development of the education and science in this country.

We have completed 25 years of our existence and during this period whatever achievements we have made will be reflected in years to come. The first publication of the Academy was in the form of a Bulletin for the year 1931-32 and covered 150 pages of original papers in the various branches of science. We are at present publishing six parts for the physical sciences and six parts for the biological sciences every year.

Pandit Jawahar Lal Nehru, presiding over our annual deliberations on March 5, 1938, remarked, "It is for this Academy of Sciences to take a lead in all such matters and to advise the Government thereon. The Government should co-operate with them and help them and take full advantage of their expert knowledge. But the Academy must not wait for the Government to give it a push every-time." We have to report here that the Academy is doing its best to improve scientific outlook of the country and to help its citizens by scientific and technological contributions as is evident from the following Symposia conducted by the Academy :—

(1) Symposium on Problems of Power Supply in India under the Chairmanship of Pandit Jawahar Lal Nehru in 1937.

(2) Symposium on the age of the Saline Series in the Salt Range of the Punjab in 1944.

(3) Second Symposium on the Age of the Saline Series in the Salt Range of the Punjab in 1945.

(4) Symposium on the Chemistry of Hydrous Oxides in 1952.

(5) Symposium on Chemical Kinetics in 1953.

(6) Symposium on Recent Trends in Soil Research in 1954.

We are anxious to play our role in all scientific development of this country and specially this State, but more funds are needed for achieving our objects.

THANKS

We wish to express our thanks to the scrutineers who have scrutinised our voting papers, to the judges for assessing the research papers for the award of the Education Minister's Gold Medal, to the Office Bearers and the Members of the Council, and the staff of the Academy for their ungruding help and co-operation through out the period under report.

FINANCIAL STATEMENT OF THE NATIONAL ACADEMY OF SICENCES, INDIA, FOR THE YEAR 1954-55.

RECEIPTS

	Rs.	as.	p.
(1) To balance with the Imperial Bank of India, Allahabad on 1st April, 1954.	392	0	3
(2) To Uttar Pradesh Government Recurring Grant for 1954-55	6,000	0	0
(3) To Government of India grant-in-aid for 1954-55	4,000	0	0
(4) To Allahabad University Recurring Grant for 1954-55 ..	1,000	0	0
(5) To National Institute of Sciences of India Annual Contributions for 1953 and 1954	2,000	0	0
(6) To Susbscriptions	1,507	12	0
(7) To Life Membership Fee	978	0	0
(8) To Bank Commission	5	10	0
(9) To Cost of Reprints	95	10	0
(10) To Sale of Proceedings	266	0	0
(11) To Donation for Opening Ceremony	250	0	0
(12) To Refund Receipts	43	14	6
Total ..	16,538	14	9

EXPENDITURE

	Rs.	as.	p.
(1) By Establishment	1,131	7	6
(2) By Dearness Allowance	541	12	0
(3) By Contingency	1,289	2	0
(4) By Publications	8,826	7	3
(5) By Binding of Journals ..	69	12	0
(6) By Separation of Life Membership Fees to Savings Bank Accounts	978	0	0
(7) By Annual Session	861	9	0
(8) By Audit Fee	75	0	0
(9) By Bank Commission	14	8	0
(10) By Closing Balance	751	5	0
Total ..	16,538	14	9

S. GHOSH,
D.Sc., F. R. I.C., F. N. I., F. N. A. Sc.,
General Secretary,
National Academy of Science, India.

R. K. SAKSENA,
D. Sc. (Paris), F. N. I., F. N. A. Sc.,
Honorary Treasurer,
National Academy of Science India.

We have audited the accounts of the National Academy of Sciences, India, Allahabad, for the year 1954-55, ending 31st March 1955, and do hereby certify the accounts to be correct to the best of our knowledge, information and belief.

G. P. JAISWAL,
for G. P. JAISWAL & CO.,
Chartered Accountants and Auditors.

November 29, 1955.

PRESIDENTIAL ADDRESS

DELIVERED AT

THE SILVER JUBILEE SESSION OF THE NATIONAL ACADEMY
OF SCIENCES, INDIA, ON 26TH DECEMBER, 1955
AT LUCKNOW

By

PROF. P. L. SRIVASTAVA, M. A., D. PHIL. (OXON.), F. N. I., F. N. A. SC.

Professor and Head of the Department of Mathematics, University of Allahabad.

HON'BLE CHIEF MINISTER, FELLOWS AND MEMBERS OF THE ACADEMY,
LADIES AND GENTLEMEN :

At the very outset my most pleasant duty is to accord, on behalf of the Academy and myself, a hearty welcome to our distinguished Chief Minister Dr. Sampurnanand who has very kindly consented to preside over the Silver Jubilee Session of the Academy. Being himself an eminent scholar, writer, scientist and patron of all good causes, this is not the first but the third occasion when he has graced our presidential chair and given us hope, faith and encouragement. Indeed his association with the Academy has been intimate and abiding; he is the person who laid the foundation-stone of our building and whose name will, therefore, remain associated with our institution for ages to come. In token of our gratitude to him, the Academy has just elected him as one of our distinguished Honorary Fellows.

On this happy occasion of the Silver Jubilee of our Academy we consider ourselves extremely fortunate that our founder Dr. Meghnad Saha is present with us today. Dr. Saha's original contributions have immortalised his name in the World of Science, and he has enhanced the prestige of our Country in the International Scientific gatherings. We cannot adequately express our indebtedness to him for his long and distinguished services to our institution, and we pray that God may spare him for many many years to serve the cause of Science and of our Country.

As you know, this Academy, the oldest of its kind in the country, came into existence on December 4, 1930, when it was registered under Societies Registration Act of 1861 with 19 Foundation Fellows, under the title of Academy of Sciences, United

SILVER JUBILEE SESSION
AT
UNIVERSITY OF LUCKNOW

26th to 28th December 1955

Prof. P. L. Srivastava delivering the Presidential Address

Provinces of Agra and Oudh. It was formally inaugurated by our First Patron, His Excellency Sir Malcolm Hailey on the 1st of March, 1932. It assumed its all India character in 1935, when its name was changed to 'National Academy of Sciences, India'. Unfortunately several of our Foundation Fellows are no more with us and today we mourn their loss. In the death at a comparatively young age of Prof. Birbal Sahni who not only adorned our presidential chair during 1938 and 1939, but also served this Academy as one of its General Secretaries for a period of 4 years, the Country lost one of its foremost Scientists and the Academy one of its main architects.

The Academy started on its career with blessings and good wishes of world renowned eminent scientists such as Prof. Einstein, Lord Rutherford, Prof. Sommerfeld, Prof. Eddington, Prof. Milikan, Prof. Siegbahn, Prof. Goldschmidt, Prof. Goodrich, Sir J. C. Bose, Sir C. V. Raman, Sir P. C. Ray and Sir James Walker, and even today we have on our rolls a large number of eminent scientists of the world as our Honorary Fellows.

Our annual meetings, which have been held at various places in India, have been presided over not only by distinguished scientists but also by such eminent leaders of our country as Pandit Jawahar Lal Nehru, Pandit Govind Ballabh Pant, Shrimati Sarojini Naidu and Pandit Ravi Shankar Shukla.

Today we recall with gratitude the name of Sir Jwala Prasad Srivstava, who as Minister of Education of this State placed in 1934, at the disposal of the Academy a gold medal to be called 'Education Minister's Gold Medal' which was to be awarded annually to the author of best research work published in the Proceedings of our Academy. This convention has been followed by his successors in office and this medal is now annually placed at our disposal by the Education Department of our Government. Among the recipients of this medal we count such eminent scientists as Prof. Birbal Sahni, Prof. N. R. Dhar, Prof. D. S. Kothari, Prof. Ram Behari and Prof. H. R. Mehra.

Till August 1953, the Academy had no building of its own and was housed in Science buildings of the Allahabad University by the courtesy of that University. We shall ever remain indebted to that great Savant Prof. N. R. Dhar, who has dedicated his life's savings to the cause of science, and who made a gift of a piece of land valued at Rs.15,000 in front of Sheila Dhar Institute of Soil Science to the Academy for constructing a building of its own. The foundation-stone of this building was laid by the Hon'ble Dr. Sampurnanand in January 1953, and its front portion was completed at a cost of Rs. 40,000 realised mainly by donations from a few notable taluqdars of Rai Bareilly through the good offices of Shri M. S. Randhawa I. C. S., The building was formally opened by Shri Chandra Bhal, President, U. P. Legislative Council in November 1954. A good portion of our building still remains to be constructed and

I feel we are justified in requesting our Government to promise us a substantial building grant on an auspicious occasion like this.

It is but meet and proper that at the end of 25 years of our existence we take a stock of our past activities and so plan our future as to be able to play a more useful and effective part in the scientific, industrial and technical reconstruction of our Country. Since we became a free nation, our leaders realising that the future progress and welfare of our Country depends upon increasing application of scientific methods to human problems, paid their special attention to the study and use of Science.

Thanks to Pandit Jawahar Lal Nehru and his co-workers, our Country possesses today several National Laboratories and Institutes where we have a band of scientific workers engaged in researches of the highest import. The success of our First Five Year Plan which has made our Country self-sufficient in food, besides giving us increased means of communications, power plants, hydro-electric schemes and hundreds of projects, is entirely due to our Scientists and Engineers. Now that the Country is launching its Second Five Year Plan, the keynote of which is the industrialisation on a large scale, our scientific workers and engineers, will be in still greater demand. Consequently we need a large number of scientific organizations for handling these nation-wide programmes. It is here that an Academy like ours can do a great deal by educating public opinion, undertaking particular problems, and producing scientific workers in various fields for national service. During the last 25 years, we have published more than 700 original papers in our Proceedings, some of which have received world-wide recognition, and have built up a decent scientific library on exchange basis. We have also published special volumes on Symposia in different subjects to which workers from abroad have also contributed valuable papers. Our Academy is a co-perating body with the National Institute of Sciences of India to which we annually elect one Vice-President and one member of the Council. Most of the grants that we have got from the Government of India for our publications have come to us through the National Institute of Sciences of India. Realising the usefulness of our work, our Members and Fellows hailing from Madhya Pradesh decided to open a branch of our Academy at Saugor at our annual meeting held at Saugor in December last. This branch is going to be formally inaugurated shortly by Pandit Ravi Shankar Shukla, Chief Minister of Madhya Pradesh.

At our anniversary meetings it is customary for the President to say something about the work in which he himself has been interested. Accordingly I have chosen the study of a certain class of Dirichlet's series for my today's address.

Dirichlet's series were, as their name denotes, first introduced into analysis by Dirichlet, primarily with a view to applications in the theory of numbers. A number of important theorems concerning them were proved by Dedekind. Dirchlet and

Dedekind, however, considered only real values of the variable. The first theorems involving complex values of the variable are due to Jensen, who determined the nature of the region of convergence of the series, and the first attempt to construct a systematic theory of the function was made by Cahen in a memoir which, although much of the analysis which it contains is open to serious criticism, has served—and possibly just for that reason—as the starting point of most of the later researches in the subject.

One of the main problems connected with a Dirichlet's series is how to study the singularities of the function represented by it. Let us recall the essential difference which distinguishes the general theory of Dirichlet's series from the simpler theory of power series. The region of convergence of a power series is determined in the simplest possible manner by the disposition of the singular points of the function which it represents ; the circle of convergence extends up to the nearest singular point, no such relation holds in the case of Dirichlet's series. A Dirichlet's series convergent in a portion of the plane only may represent a function regular and all over the plane, or in a wider region of it. The result is (to put it roughly) that many of the peculiar difficulties which attend the study of power series on the circle of convergence are extended, in the case of Dirichlet's series to wider regions of the plane or even to the whole of it.

One method of studying the singularities of

$$(1)\quad H(s)=\sum_{p}^{\infty}\phi(n)\,e^{-s\,f(n)},\ (s=\sigma+it),$$

would be to express, when possible, the function H(s) in the form

$$(2)\quad H(s)=\sum_{p}^{\infty}\phi(n)e^{-s\,f(n)}=G(s)+\int_{p}^{\infty}\phi(x)e^{-s\,f(n)}d(x)=G(s)+J(s),$$

where G(s) is an integral function of s, so that H(s) has no other finite singularities than those of J(s)

Now Dr. Cramer, observing that the relation (2) is true of the series $\sum_{1}^{\infty} n^{-s}$, showed* that it is also true of a general class of series

$$(3)\quad \sum_{1}^{\infty}\phi(n)n^{-s},$$

which is characterized by the following two conditions :

(4) $\phi(x)$ *possesses derivatives of every order*, $(x\geqslant 1)$;

*Sur une de classe series de Dirichlet, These pour le doctorat, Uppsala, 1917,

(5) *there exists a real constant* k, *such that for sufficiently large values of* x

$$\phi\mu(x)=O(x^{k-\mu\sigma}),\ (\mu=0,1,2,3,..),$$

c *being a positive number* $\leqslant 1$.

This is the fundamental result of Cramer's thesis, suggesting a new approach to the study of a class of Dirichlet's series. What is, however, surprising is that Dr. Cramer did not consider Dirichlet's series of types other than *log n*. The work thus left over has, in a great measure, been completed by me. I have shown, for example, that the application of the Euler-Maclaurin sum-formula† on which the proof of Cramer's theorem rests, to series (1) is successful if $\phi(x)$ and $f(x)$ are continuous functions of a real variable x, satisfying certain other sutiable conditions, and $f(x)=O(\log x)$. Thus I prove a theorem from which Cramer's theorem follows as a special case.

Theorem.—The relation (2) *is true of the series* (1), *if* $\phi(n)$ *satisfies* (4) *and* (5) *for* $x\geqslant p$, *and* $f(x)$ *satisfies the following two conditions* :

(6) $f(x)$ *is a positive monotonic function of* x, *and possesses derivatives of every order*,

(7) $f(x)\longrightarrow\infty\log x$, $f^{\mu}(x)=O(x^{-\mu})$, $(\mu=1,2,3,..)$

While studying Dirichlet's series of types lower than log n, we meet with divergent series such as

$$(8)\quad \sum_{1}^{\infty} e^{-s(\log n)^{\alpha}},\ 0<a<1,\ \sum_{3}^{\infty} e^{-s(\log\log n)},$$

for which the relation (2) ceases to have a meaning. *What can, however, be shown is that, if* (1) *be a divergent series, and* ϕ *and* f *satisfy some suitable conditions.*

$$(9)\quad \lim_{N\to\infty}\left\{\sum_{p}^{N}\phi(n)e^{-sf(n)}-\int_{p}^{N}\phi(x)e^{-sf(x)}\,dn\right\}\ \textit{exists uniformly in } D, \textit{ where}$$

D denotes any finite region included in a certain half-plane, and defines a function which is an integral function of s.

This result has led to an idea which is utilized to define a mode of summation for certain divergent series. In fact, we can define our divergent series (1) by means of $\lim_{z\to 0} H(s,z)$, where

$$(10)\quad H(s,z)=\sum_{p}^{\infty} n^{-z}\phi(n)e^{-sf(n)},$$

provided this limit exists,

Thus the divergent series

†Lindelof, *Le calcul des residus*, pp,78 et seq.

$$(11)\quad \sum_{1}^{\infty} n^{k} e^{Ai\,n^{\beta}-s(\log n)^{a}},\ (A\neq 0,\ 0<\beta<1,\ 0<a<1,\ k>\beta-1),$$

$$(12)\quad \sum_{1}^{\infty} n^{k} e^{Ai(\log n)^{\lambda}-s(\log n)^{a}},\ (A\neq 0,\ \lambda>1,\ 0<a<1,\ k>-1),$$

of which the first is also summable (C) all over the plane, are defined uniquely by means of integral functions of s.

Similarly, by the application of a formula of Boole*, it has been possible to effect the analytic continuation over the whole plane of functions represented by certain Dirichlet's series of the form

$$(13)\quad \sum_{p}^{\infty}(-1)^{n}\phi(n)e^{-sf(n)}$$

in their half-planes of covergence only.

There exist Dirichlet's series, however, to the study of which the 'real variable' method suggested by Dr. Cramer is not applicable, but which can be shown to satisfy a relation of the type (2) all the same by the use of Cauchy's theorem on residues. Thus it has been possible to study the analytic continuation of a class of Dirichlet's series which is characterized by the fact that ϕ and f are analytic functions of z in a certain region T enclosing the positive real axis from a certain point (say, $z=\beta$, $p-1<\beta<p$) onwards, and that they satisfy certain other conditions as to their order of magnitude and for which series a relation of type (2) may be shown to exist by means of the formula.

$$(14)\quad \sum_{p}^{n}\phi(\lambda)e^{-sf(\lambda)}=\int\frac{\phi(z)e^{-sf(z)}\,dz}{se^{2\pi i z}-1},$$

S being a closed contour lying entirely in T, and enclosing within it no other pole of $\left(\frac{1}{e^{2\pi i z}-1}\right)$ except $z=p,\ p+1,..,n$.

It follows from the theorems obtained in this manner that a relation of type (2) is true of the series.

$$(16)\quad \sum_{1}^{\infty} e^{-s(\log n)^{a}},\ (a>1),\ \sum_{1}^{\infty} e^{-sn^{\alpha}},\ (0<a<1).$$

*Lindelof, *loc, cit*,, pp, 78 et seq.

But the method breaks down if the type of a Dirichlet's series is higher than n.

These theorems have enabled us to prove that the functions represented by the series.

$$(17)\quad \sum_{1}^{\infty} e^{Ai\,(\log n)^{\beta}-s\,(\log n)^{a}} \quad (A\neq 0,\ \beta > a > 1),$$

$$(18)\quad \sum_{1}^{\infty} e^{Ai\,n^{\beta}-sn^{a}} \quad (0 < a < \beta \leqslant 1,\ A\neq 0 \text{ when } \beta < 1, \text{ and } A \neq a \text{ multiple of } 2\pi, \text{ when } \beta = 1),$$

none of which is summable (C), or by Riesz's typical means for any value of s whose real part is negative are integral functions of s.

By properly generalizing the method (mentioned earlier) of defining some divergent series, and making use of the results referred to above, we have been able to define a divergent series such as

$$(19)\quad \sum_{1}^{\infty} e^{Ai\,n^{\beta}+Kn^{\lambda}-sn^{a}}, \quad \left[\ 1 \geqslant \beta\lambda > a > 0, k > 0,\ A \text{ and } \beta \text{ connected as in (18)}\ \right],$$

by means of an intergal function of s.

While talking of the methods of summing up divergent series, I would recall how the late Srinivasa Ramanujan, the greatest Indian Mathematician of modern age, communicated to Prof. Hardy, the sum of his divergent series $1+2+3+4+\ldots$ as $-\frac{1}{12}$. In his letter dated February 27, 1913, written from Madras, Ramanujan says:

'I told him that the sum of an infinite number of terms of the series $1+2+3+\ldots = -\frac{1}{12}$ under my theory. If I tell you this, you will at once point out to me the lunatic asylum as my goal. What I tell you is this. Verify the results I give and if they agree with your results, you should at least grant that there may be some truths in my fundamental basis'

Ramanujan was quite ignorant of the work done by such earlier mathematicians in the field of divergent series as Euler, Abel Cesaro, Holder, Borel, Riesz, Lindelof etc. What he meant to say was that for values of s for which $\sum_{1}^{\infty} n^{-s}$ was divergent, and the zeta function had a value, that value would define the sum of the series.

It is in this way that Ramanujan gave the sum of divergent series $1+2+3+\ldots$ by $z(-1)$ which is equal to $-\frac{1}{12}$.

There is yet another formula due to Mellin * which I have successfully employed in establishing the following results :

$$(20)\quad H(s,\lambda) = \sum_{1}^{\infty} n^{\lambda}\, e^{-sn^{a}}, \quad (0 < a < 1 \text{ s and } \lambda \text{ independent complex variables})$$

*Math. Aurnalen Vol. lxviii,

$$= \frac{1}{a}\,\Gamma\left[\frac{1+\lambda}{a}\right] s^{-\frac{(1+\lambda)}{a}} + \sum_{0}^{\infty} \frac{(-s)^{n}}{n!} z\,(-an-\lambda)\ ;$$

$$(21)\quad H(s) = \sum_{1}^{\infty} e^{Ain^{\beta}}\, n^{-s} = \frac{1}{\beta}\,\Gamma\left(\frac{1-\alpha}{\beta}\right)\left(Ae^{-\frac{\pi i}{2}\alpha}\right)^{\frac{\alpha-1}{\beta}} + \sum_{0}^{\infty} \frac{(Ai)^{n}}{n!} z\,(s-\beta n).$$

Quite recently one of my pupils Dr. Nirmala Pandey has applied the 'complex method' to study series which are combinations of factorial and Dirichlet's series. One of her results is that the function represented by the series

$$\sum_{2}^{\infty} e^{Ai\,(\log n)^{\beta}-s\,(\log n)^{a}} \frac{\Gamma(n)}{\Gamma(z+n)}$$

is an integral function of both s and z, provided

$\beta > a+1$, and $a \geqslant 1$, and $A > 0$

As a further application of the 'complex method' we have been able to study the analytic continuation of the Dirichlet's series

$$(22)\quad F(S) = \sum_{0}^{\infty} \phi(n)\, e^{-sn}, \quad (|t| \leqslant \pi)$$

$$(23)\quad H(S) = \sum_{1}^{\infty} \phi(\log n)\, n^{-(s+1)},$$

Where $\phi(z)$ is an analytic function of $z\ (= se^{i\psi})$ in the angle $|\psi| \leqslant a$ $(a<o)$ and satisfies certain other conditions as regards its order.

Now the analytic continuation of the series (22) has been studied, among others, by Lindelof* and Carlson, † both of whom have however, invariably assumed that $\phi(z)$ is an analytic function of $z\ (= \rho e^{i\psi})$ at least in a half-plane. I have shown that under certain conditions we can effect the analytic continuation of F(s) beyond the line of convergence, even when $\phi(z)$ is an analytic function of z in the angle $|\psi| \leqslant a$, $0 < a < \frac{\pi}{2}$; and that the problem admits of an exact converse.

This generalization of Carlson's theorems important in itself, proves useful in establishing certain other important results.

*Loc. Cit., Chapter V.

†Sur une classe de Taylor, These pour la doctorat, Uppsala. 1914.

A knoweldge of the results established in connection series (22) is utilized in studying the finite singularities of the function H(S) represented by the series (23). Thus the following theorem establishes an important and interesting connection between the singularities of the series (22) and (23), when ϕ satisfies certain conditions.

Theorem :— *If*

(24) $\phi(z)$ *be an analytic function of* z *in the angle* $|\psi| \leqslant a$, *whose* $a \geqslant \frac{\pi}{2}$,

(25) $\phi(z) = O(e^{k|z|})$, *where* $k < \pi$, *throughout this region, then*

all the finite singularities of H (S) *are identical with those of* F (S) *lying in the strip* $|t| \leqslant \pi$.

This result has appeared in *Comptes Rendus*, and been noticed in *Science Progress.*

Another theorem established in an almost similar way is the following :—

Theorem :—*If in* (23), ϕ *satisfies the following conditions* :

(28) $\phi(z)$ *is an analytic function of* z *in the angle* $|\psi| \leqslant a$, $a > 0$;

$$(29)\ \lim_{\rho \to \infty} \sup. \frac{\log |\phi(\rho e^{i\psi})|}{\rho} = \lambda(\psi),$$

where $\lambda(\psi)$ *is continuous for* $|\psi| < a$, *and bounded for* $|\psi| \leqslant a$; *then a point* P *on the finite part of* Σ, *in the neighbourhood of which there is no straight piece of the curve, nor which lies on one of the extreme tangents to* Σ, *is a singular point of* H (S).

In particular, H (S) *cannot be an integral function of s. Hence it also follows that* $\phi(\log n)$ *can not vanish for all positive integral values of* n.

Then again, the method employed has been used to study the analytic continuation of Taylor's series $\sum_0^\infty c_\gamma z^\gamma$ by means of its associated intgral function $a(z) = \sum_0^\infty \frac{c_\gamma z^\gamma}{\gamma!}$, and the converse problem.

The main result is embodied in the following theorem

Theorem :—*Suppose a closed convex curve* Γ *in the z-plane is given by* $p = \lambda(\psi)$, $(|\psi| < \pi)$, *where* $\lambda(\psi)$ *is continuous* $\lambda^1(\psi)$ *has at most discontinuities of the first kind, and*—$k \leqslant \lambda(\psi) \leqslant k$, (k *finite and positive*), *the value* k *attained for at least one value of* ψ ; *then the necessary and sufficient condition that* $f(z) = \sum_0^\infty c_\gamma z^\gamma$ *be a branch of an analytic function, regular and uniform in region containing the origin and enclosed by a curve* C, *but not in any more extensive region of the same character,* C

being the simple inverse of Γ *(with respect to the origin), turned through a right angle in the positive direction, is that*

$$|a(p e^{i\psi})| < e^{\rho(\lambda(\psi)+\varepsilon')}, \text{ for } |\psi| \leqslant \pi,$$
every $\varepsilon' > 0$, and $p \geqslant p_0(\varepsilon')$,

$a(z)$ *being the intergral function* $\sum_0^\infty \frac{c_\gamma z^\gamma}{\gamma!}$

Those points on C *which correspond to such points on* Γ *as have* $\lambda'(\psi)$ *continuous, are singular points of* f (z). *Nothing c n the be said as regards other points on* C.

This theorem leads to several interesting results. Wigert* has proved *that the necessary and sufficient condition that* $f(z) = \sum_0^\infty c_\gamma z^\gamma$ *should be an integral function of* $\frac{1}{1-z}$ *is that there should be an integral function* $\phi(z)$ *of order* 1 *and type zero which takes the values* $c_1, c_2, c_3, \ldots$ *for* $z = 1, 2, 3, \ldots$

The theorem just stated gives an alternative necessary and sufficient conditions as follows :—

The necessary and sufficient condition that $f(z) = \sum_0^\infty c_\gamma z^\gamma$ *not regular for* $z = 1$, *be an integral function of* $\frac{1}{1-z}$ *is that the associated integral function* $a(z) = \sum_0^\infty \frac{c_\gamma z^\gamma}{\gamma!}$ *should satisfy the asymptotic equality*

$$\lim_{\rho \to \infty} sip. \frac{\log |a(\rho e^{i\psi})|}{\rho} = \cos\psi, \ (|\psi| \leqslant \pi).$$

Similarly, we can construct Taylor's series for whose sum-function the line $R(z) = 1$, or the circle of radius round the point $z = \pm\sqrt{1+a^2}$ be a singular line.

Lastly, Dr. Nirmala Pandey has obtained a generalization of Hurwitz's theorem†, and shown that

$$J_s(s) = \int_0^\infty \phi_1(z)\, e^{-sz}\, dz$$

has no other singularities except possibly those that may be obtained by adding to singularities of

$$J_2(s) = \int_0^\infty \phi_2(z) e^{-sz}\, dz$$

*G, H, Hardly 'On two theorems of F, Carlson and S, Wigert', Acta Mathematica, Vol. 42

†Hadamard ; *Taylor Series*, p, 73,

to those of $$J_1(s)=\int_0^{\infty}\phi_1(z)e^{-sz}dz,$$

where $\phi_1(z)$ and $\phi_2(z)$ are anlytic functions in $R(z)\geqslant O$, and satisfy relations of the type $\phi_1(z)=O(e^{k_1|z|})$ and $\phi_2(z)=O(e^{k_2|z|})$,

Hurwitz's theorem is obtained if $\phi_1(z)$ and $\phi_2(z)$ are integral functions of exponential type.

The question that arises is :—

Whether the result is true if $\phi_1(z)$ and $\phi_2(z)$ are analytic functions in the angular region $|\psi|\leqslant a$, where $O<a<\frac{\pi}{2}$. This has not been proved so far, and I must leave it to the workers in this field to tackle it.

SILVER JUBILEE SESSION AT UNIVERSITY OF LUCKNOW

26th to 28th December 1955

Dr. Sampurnanand delivering the Inaugural Address

INAUGURAL ADDRESS

By

Dr. SAMPURNANAND

Chief Minister of Uttar Pradesh

THIS is the third time that I am addressing members of the National Academy of Sciences. The prospect of meeting some of those who occupy a leading position in the world of science is always a pleasing one, although, it must be confessed, it is not very easy to make up one's mind about what one should say in one's address to such a gathering.

It would be easy enough for me to lecture to you about the numerous faults of omission and commission which can be, quite justifiably, laid at the door of scientists. It is the barest truth that the Scientist belongs to the class of Brahmans of present-day society and he is false to himself, his vocation and his class, to the extent that he allows himself to be made a puppet of the Kshattriya. Leaders of political parties and of the capitalist world wield immense power. They can make a man's life miserable, if they so wish, but the scholar, the votary of Saraswati, bows his head before no man. His talents cannot be traded for money. His knowledge of the secrets of nature, if it is not a gift of the dark elementals of the other world, can only be placed at the service of the forces that seek to unite men. Science is not a medley of isolated disciplines : it is an integrated whole, a whole which is greater than the sum of its parts and its outer fringes are coterminous with the domains of Religion and Philosophy. Scientific thought has already begun to stimulate religious and philosophical thinking. The God to whom the preacher refers today is omnipresent, omnipotent and omniscient in a sense that was inconceivable to the theologian a few centuries ago : the universe over which he presides is vaster, more varied and, in spite of recent advances in knowledge, more incomprehensible than the world of the past.

Science is prepared today to investigate phenomena which were formerly the valued experience only of a privileged few : it wants to explore those physiological and nervous reactions which are connected with the practice of yoga. Religion, as a matter of fact, cannot ask for a better friend than Science. And Science itself is today glimpsing the truth of the profound teaching that the substratum of all phenomena is one, that there is no impassable barrier between the living and the non-living. The mechanistic universe which Science had created is already a thing of the past. I have no doubt that the day is not far distant when scientists themselves will come fully to realise that subject and object are really different aspects of one whole, whose nature is expressed in the words of the Upanisads as विज्ञान ब्रह्म . The Absolute Reality is

pure knowledge, pure consciousness. The person to whom a realization of this truth has come, however, dimly, will never willingly associate himself with activities that tend to disrupt peace or foster greed, pride and hatred. Such emotions are a violent denial of the truth which distinguishes Science from a string of empirical formulae of doubtful application and still more doubtful correspondence to reality.

I can only bring to your notice a few questions which come to the mind of a layman like me. Limited as our financial resources are, we are launching on vast schemes of national development. Many of these schemes depend for their success upon the active co-operation of scientists. This co-operation is certainly forthcoming. But I wish our scientists could see their way to take more initiative in the matter. The solution of problems set to them by Government or Industry is necessary but the making public of the solutions of problems, taken up on their own initiative for consideration because of their intrinsic importance to the country's good is equally so.

There must be many directions in which, even within our limited resources we have failed to apply fully the lessons of Science ; you have to bring those instances to the notice of the Government and the public alike. It is not inconceivable that we of the tribe of politicians should, in the beginning, refuse to listen to you, but the anticipation of such behaviour on our part does not absolve you from the responsibility of making, according to your lights, every effort to make the life of the people richer and better. Truth will prevail in the end and your advice is bound to be followed. You are, no doubt, handicapped by lack of resources but again that does not lessen your responsibility. Take Uttar Pradesh for instance. It is not only a large State, speaking in purely territorial terms, but a great State. All the same, unless very vigorous efforts are made, it seems doomed to a purely agricultural economy and yet it is difficult for many of us to believe that nothing can be done to relieve this monotonous feature. There must be minerals somewhere below the surface. Apart from the services which engineering and electricity are rendering, there must be other ways also of raising the standard of life of the people, and we look to our men of sicence to point out the way.

I do not want any one to believe for a moment that I confine my attention purely to the applications of science. I know that nations, like individuals, cannot live for long on what they borrow from others. Application of scientific knowledge can flourish effectively only in an atmosphere of fundamental research. Such researches cannot be carried on without much outlay of money, and quick results cannot be expected. It is difficult in our country to convince many members of our legislatures of the utility of finding money for the purpose, but the sooner we realize the importance of the place which fundamental research occupies the better it will be for all concerned. It may be that some branches of fundamental reasearch may appear to us to be of doubtful

utility. It is for scientists themselves to decide if some of the purposes for which money is asked in the way of research cannot be conveniently left out in the beginning. But the scientist has to keep his vision broad and high. Only recently in the course of my Convocation Address at Roorkee I referred to space flight. I have no doubt that if international jealousies would allow themselves an overdue holiday it should not be beyond the powers of the technique available today to manufacture an artificial satellite and start on a journey to the Moon within the next ten years. It is first lap of the journey that will be the most difficult. Other voyages will not necessarily be so difficult. People are already engaged in carrying on researches about fuels and the alloys of which the future rocket will have to be made, if it is to withstand the the terrible temperatures outside the terrestrial atmosphere. Tests are also being made to see how far the human body can withstand the unusual gravitational pressures to which it will have to be subjected, and its physiological and psychological effects. I wish it were possible for our country to make some contributions in this direction. We have experimented on rockets in the past. History tells us that Hyder Ali's army used rockets so effectively in war against the British that it began seriously to be discussed in Europe that rockets should be made a regular part of the equipment of the armed forces. It was only the invention of very powerful guns that allowed the idea to be dropped. It should certainly not be impossible for us to carry on the psychological and physiological tests here. I speak about space travel because the subject has a great fascination for me. Everybody is not necessarily interested in it. I use it only as an illustration. There are innumerable fields in which there is room for research. Some of the results of research of kind are bound to yield material gains. It would be possible to apply them to the practical service of society in the near future. What I am pleading for is that research, the addition to the store of human knowledge, has a value and significance in itself, apart from the uses to which it might lend itself. I can only hope that more and yet more money will be made available for the purpose. There is plenty of talent in the country. Some of the youngmen who come out of our universities would really be brilliant scientists if money could be made available to them, and the men of science could be assured of that minimum of comfort and convenience without which no concentrated effort is possible. I know it is not in the hands of scientists to provide these conveniences for themselves. It is the responsibility of governments. I also wish that our moneyed men and captains of industry could realize that they have also a great responsibility in this matter. Applications of scientific knowledge have, of course, an immediate relevancy to their problems but they should know that there can be no application if there is no knowledge to be applied. They should generously finance institutions where researches can be carried out.

When we speak of science we generally think of the physical sciences,but your

Academy, I understand, has not circumscribed its sphere of activities in this manner. There are certain branches of knowledge which stand on the borderline between physical science and some other branches of knowledge which are not amenable to the laboratory methods of weighing and measurement. Psychology comes easily to mind in this connection. In a country like India we have a long tradition of spiritual experience, not merely spasmodic, uncontrollable and unpredictable experience of a man here and there, but a regular technique for inducing such experience. Surely, it is worthwhile exploring this avenue. It is necessary in this connection fully to follow the established technique and to see where it leads us. The boundary between matter and spirit is thin. As a matter of fact, it is a product of human speculation. It may be that research along the right lines carried on in a spirit of reverence and humility may lead not only to greater knowledge but to opening up new paths which lead to greater knowledge. Knowledge is power and it may be that in this way we might gain access to power to which we are at present strangers. Perhaps what I have said is unorthodox, but there is no reason why I should repeat what you have so often heard.

Since, indeed, all knowledge has to be unfettered, it would be fatal for humanity if the pursuit of knowledge were to be bound by the dictates of any political or economic theory. We have before our eyes the danger that results from such a procedure. Examples are not unknown of great scientists, historians and men devoted to other branches of learning, having to make a humble recantation of the results of their thinking or research if it happens not to concide with the particular dogmas held dear by the dictatorship that rules that particular country. This must not happen. But there is another kind of conformism which we may reasonably expect from our scholars. The pursuit and dissemination of knowledge is justified only to the extent that it serves the purpose of शिवेतर क्षति. The removal of that which is अशिव, that is not conducive to the best interests of mankind. The National Academy of Sciences can render a great service if it can give a much needed lead, of advancing the cause of science and bringing about the interlinking of scientific konwledge with a sound philosophical system which shall integrate all aspects of truth into one whole, radiating light into every corner of individual and communal existence.

There is a problem which deserves serious attention from scientists. I think I have referred to it in public more than once. In a country with a predominently agricultural economy like ours meteorological knowledge is of the greatest practical importance. The cultivator, particularly while tackling his kharif crop, has to be correctly guided at every step. There is a vast amount of such knowledge stored up in popular proverbs. Such proverbs are quite obviously based on agelong observation but the observations were not made by experts. They are bound to be sketchy and

defective in some cases and generalisations have probably been made on the basis of very insufficient data. All the same, they probably contain, at the same time, a good deal that is valuable, and, in any case, they have still a hold on the cultivators mind. They take into account not only the direction of the wind and the form of the clouds but the behaviour of certain birds and animals. It is very necessary that a detailed study should be made of such proverbs to enable the truth underlying them to be sifted from the untruth. In this connection, mention should also be made of weather forecasts in the Punchangas. It is necessary that these also should be studied. It would be a very great national service if this were to be taken up methodically by scientists with unprejudiced minds.

I should like incidentally to make a reference to the publication of the Report of the Calendar Reform Committee presided over by Dr. Megh Nad Saha. The Report makes recommendations of very wide application and it is a matter of personal satisfaction to me that some of the suggestions I made to it have been found worthy of acceptance. My only complaint is that the Report has not gone far enough. In the first place, it should have recommended that the date of the beginning of the year should be put back so as to coincide with the date on which the sun enters *Mesha*. I am sure that, in spite of the perplexity that this would have caused in the public mind, the recommendation would have been accepted. Another lacuna in the Report is the non-fixation of the first point of Aries which should also be the first point of *Ashwini* as well. I have suggested, as have so mny others, that this should be a point exactly 180° from *Chitra* (Spica). The Government of India should lose no time in giving official recognition to the Report so far as it goes.

Preparation of a good star atlas giving Indian names of stars and constellations where such are available and other astronomical data is also long overdue. I trust that the observatory which is to be established by the U. P. Government will take this up at an early date. But the co-operation of others will also be necessary for the successful completion of this task. You will be interested to know that arrangements are being made to enable our observatory, even though it is at present in a highly unfinished condition, to make observations of Mars when it will be in its perigee next autumn.

I trust you will excuse me if I make a passing reference to something that is considered highly unorthodox. I am referring to Astrology. For no reason that I have been able to understand, the study of this subject is considered to brand an individual as a person of inferior intelligence. The student of Astrology is required, in the first instance to explain how Astrology can possibly be a science. How, for instance, the stars, to use a popular though rather inaccurate expression, can affect human destiny. I should like to point out that this is a highly unscientific attitude. In science facts

come first. They are followed at a much later date by hypotheses and explanations. If the validity of facts like the falling of apples towards the ground and the movements of planets round the sun according to Kefler's laws had not been admitted, there would have been no justification for working out the principles of gravitation. As a matter of fact, the fact of gravitation was universally admitted even though the acceptance of the explanations thereof was not. Many people were not satisfied with the Newtonian hypothesis ; possibly, even Einstine's theory may be given up in the future. Similarly, let the sceptic first investigate the facts posited by astrologers. Let them see if such facts exist, then there will be time enough to think of scientific explanations. To refuse to investigate what certain people assert with confidence to be facts is to betray a highly unscientific mentality.

It will not be possible for me to attend your meetings everyday. I hope you will excuse me for this . I wish you a very successful session. A Silver Jubilee is a great occasion, a very important landmark in the life of an institution. Let me hope that you will step now into a period of grater and more fruitful service to humanity.

PRESIDENTIAL ADDRESS

DELIVERED AT

The Physical Sciences Section during The Silver Jubilee Session of The National Academy of Sciences, India on 27th December, 1955 at Lucknow

By

PROF. A. C. CHATTERJEE, D. Sc., Dr. Ing., F. N. A. Sc.,

Head of the Department of Chemistry, University of Lucknow

I am thankful to the authorities of the National Academy of Sciences for giving me the opportunity to preside over this session. I am fully alive of my shortcomings and I hope you will in your generosity excuse me for these.

I wish to place before you some ideas on chemical kinetics which have been pursued in the chemical laboratories of the Lucknow University for the past four years.

Although chemical reactions have been studied from the early days yet advances which enable us to calculate the rate of chemical reactions from first principles, utilising only such fundamental properties as the configurations, dimensions, interatomic forces, etc. of the reacting molecules, have only been achieved very recently. By the application of quantum and statistical mechanics the theory of absolute reaction rate has been developed according to which the rate is given by

$$K = k\frac{kT}{h}\quad\frac{F_*}{F_A.F_B.....}\,e^{-F_0/RT}$$

One of the fundamental postulates of this theory is that the initial reactants and products when produced are in equilibrium with the activated complex. This means that the concentration of the complex can be calculated accurately by statistical mechanics in terms of the concentration of reactants. Further, the assumption now made is that even when equilibrium is not established between reactants and resultants, the complex is in equilibrium with reactants. Hence we can say that the complex is always in equilibrium with the reactants.

The complex is supposed to be at the top of an energy barrier lying between the initial and final stages and the rate of the chemical reaction is given by the velocity at which the activated complex travels over the top of the barrier. It is convenient to define an activated state to exist at the top of the energy barrier in a potential box of length δ, the actual magnitude of which is immaterial since it cancels out in the final expression. The number of complexes crossing the barrier per unit volume and in unit time give the reaction velocity when every complex that crosses the barrier, falls to pieces. The configuration of the activated state possesses all the properties of an ordinary molecule except that the normal vibration frequency in the direction of decomposition has an imaginary value. This means that the activated complex is stable for atomic displacements in all directions except one ; and in the latter direction it falls to pieces. If the energy barrier in the vicinity of the activated state is relatively flat, then the degree of freedom in the decomposition coordinate may be considered statistically as an unidimentional translation, which means that the vibrational degree of freedom is converted for all practical purposes into a translatory one, in the direction of decomposition coordinate (Laider, Chemical Reaction page 66, 1950). The theory of absolute reaction rate as indicated above is very closely associated with the theory of chemical equilibrium, but it must be pointed out that equilibrium theory alone cannot give us any information about rates. The equilibrium theory concerns itself solely with the calculation of the concentration of activated complexes in terms of those of the reactants. Thus in the above treatment a fundamental problem remains to be solved. It is the calculation of the rate of decomposition of the activated complex and only quantum mechanics seems to offer an answer (Golden J. Chem. Phys. 17, 620-630, 1949).

The Science of chemical kineties may be of interest in itself, as for example, in determining, how changes in the environmental conditions change the rate of a given reaction or from a practical point of view one may be interested in the rate of chemical change which is industrially important. But chemists in general are interested in chemical kinetics as it provides the most general method of finding out the mechanism of reactions. Here the mechanism means all the individual collisions or other elementary processes that take place simultaneously or consecutively in producing the observed overall reactions. It is apparent that true mechanism of any reaction cannot be predicted from the overall reactions alone. It is necessary to know the various individual simple processes that produce the overall reaction.

In addition to this definition, there is a newer concept which includes not only a complete knowledge of all the individual steps in the overall reaction but a detailed stereochemical picture of each step as it occurs. This means that we should know not only the composition of activated complex in terms of the various reactants but also of the geometry of the activated complex in terms of interatomic distances and angles.

In order to know this accurately, it is necessary to employ other methods of obtaining informations about mechanisms, which may be incomplete in themselves but when taken in conjunction with kinetic studies give valuable informations. The most important circumstantial evidence revealing the nature of mechanism is the identity of reaction products. It is also evident that an intimate detail of the mechanism of the reaction can be known by knowing the stereochemistry of the reactants as well as that of the resultants.

Intimate knowledge about the mechanism of chemical reactions can be obtained by the use of isotopes when one set of bonds is broken and replaced by another set. The increased production of isotopes of the more common elements have led to an increasing application of this technique in studying reaction where mechanisms could not be determined by other means.

Another method that has been successfully applied to elucidate the mechanism of chemical reactions is to demonstrate the existence of short-lived intermediates by trapping them with the help of added substances so as to produce stable compounds or by observing some specific physical or chemical property of these e.g., mass-spectrogram, absorption spectrum or removal of metallic mirrors.

A very suitable method to study reaction mechanism is to produce refinements in kinetic methods. Such devices as studying the effect of substituents on the rate of a given reaction or the effect of changing the solvent or the ionic strength can be used profitably to elucidate the mechanism. The substituents can be either electron attracting or electron-repelling. In a similar manner, the effect of changing the dielectric constant of the solvent or the ionic strength can be used in conjunction with modern theories to give strong evidence that the reaction is between a negative ion and a neutral, but polar molecule.

In a series of work undertaken in this laboratory, oxidation of alcohols and aldehydes by chromic acids under constant ionic concentration has been studied with a view to establish the constitution of the complex and to find a mechanism of oxidation. Simultaneously the chemical kinetics and the energy of activation of such reactions have been studied with a view to obtain a more detailed picture of the mechanism.

Some of the results obtained are given here.

The oxidation of n-Butyl, Sec-Butyl, Sec-Hexyl alcohols have been studied in presence of perchloric acid as the source of H^+ ions. The total ionic strength of the reaction mixture was kept constant at 0.4 M by adding sodium perchlorate in the required quantity, if necessary. For details the description given in symposium on chemical kinetics, proceedings of the National Academy of Sciences (India) 23A, 20, (1954) and Z. anorg. und Allg. Chemie 280, 110, (1955) should be consulted.

In addition to the above alcohols, the oxidation of n-propyl and capryl alcohols has also been studied.

The order of the reaction with respect to the alcohol, H^+ ion and chromic acid has been determined. The temperature coefficients between 25° and 35° C have been determined for all the reactions. The frequency factors have been calculated from the equation, $K=Ae^{-e/Rt}$. The induction factor in the case of Sec-butyl and Sec-hexyl alcohols which induce the oxidation of manganese sulphate to manganese dioxide by chromic acid, has been determined. From a knowledge of the above results a mechanism of the oxidation of the alcohols has been suggested.

TABLE I

Oxidation of alcohols : Order of the reaction

Alcohols used	Reactants with respect to which order has been found	Concentration range in gm. moles per litre	Order	Total order
n-Propyl alcohol	Chromic acid	0.1 -0·001	1	
	n-Propyl alcohol H^+	0·2630 - 0·0527	0·95-1	
		0·03995 - 0·02663	1·22	3 at low H^+ conc.
		0·5326 -0·1332	1·7-1·9	4 at higher H^+ conc.
n-Butyl alcohol	Chromic acid	0.1 - 0·001	1	
	n-Butyl alcohol H^+	0·2161 - 0·04322	0·76 -1·1	
		0·03204 -0·021361	1·32	3 at low H^+ conc.
		0·2316 -0·1158	2·18 -2·16	4 at higher H^+ conc.
Sec.-Butyl alcohol	Chromic acid	0·01 -·001	1	
	Sec-butyl alcohol H^+	0·2152 -0·04304	1·12 -0·95	
		0·03474 -0·01158	1·04 -1·01	3 at low H^+ conc.
		0·03742 -0·1498	1·9 -1·8	4 at higher H^+ conc.

Alcohols used	Reactants with respect to which order has been found	Concentration range in gm. moles per litre.	Order	Total order
Sec-hexyl alcohol	Chromic acid	0·1 -0·001	1	
	Sec-hexyl alcohol H^+	0·1248 -0·03121	1·37 -0·91	
		0·04634 -0·02317	1·06 -0·93	3 at low H^+ conc.
		0·4634 -0·1159	1·79 -1·51	4 at higher H^+ conc.
Capryl alcohol	Chromic acid	0·04253 -0·001033	1	
	Capryl alcohol H^+	0·1242 -0·02484	0·81 -0·44	
		0·05326 -0·02663	1·38 -1·24	3 at low H^+ conc.
		0·3196 -0·1065	2·18 -2·04	4 at higher H^+ conc.

From the above table it can be stated that the order of the reaction with respect to chromic acid is one, with respect to the alcohols it is very nearly one. The order with respect to H^+ion varies with the concentration of the ion. At low concentration upto 0·05 M, the order is very nearly one, whereas at higher concentration upto 0·4 M, the order appears to be two.

In the oxidation of capryl alcohol the values range from 0·44 to 0·81. This shows that the oxidation of acetone, the solvent used for dissolving capryl alcohol in aqueous solution probably complicates the reaction. At the higher concentrations of the alcohol, the precentage of chromic acid reduced by acetone is smaller when compared to that reduced by the alcohol. Hence with increase in the concentration of the alcohol, the order tends to be one and the anomalies disappear. Hence the correct order very probably is one.

TABLE II

In this table, the temperature co-efficient, energy of activation and the frequency factor for the above oxidation reactions have been given. Results marked with an

astricks have been executed with identical set of concentration. Others have been undertaken at different conc.

Alcohol	Temp. range °C	Temp. Coeff.	E. K. cals	A
n-Propyl alcohol	35-25	2·013*	12·76	$2·1\times10^{17}$
	,,	2·028	12·90	$4·7\times10^{17}$
	,,	2·006	12·70	$5·5\times10^{17}$
	45-35	1·821*	10·94	
	55-45	1·697*	9·26	
n-Butyl alcohol	35-25	1·840*	11·13	$6·4\times10^{14}$
	,,	1·886	11·58	$5·3\times10^{15}$
	,,	1·968	12·35	$1·5\times10^{17}$
	40-30	1·663*	9·28	
	50-40	1·596*	8·53	
Sec-Butyl alcohol	25-15	2·227*	14·61	
	35-25	2·044*	13·04	$1·2\times10^{18}$
	,,	1·961	12·32	$6·7\times10^{16}$
	35-25	2·094	13·52	$3·8\times10^{18}$
	,,	2·019	12·85	$1·5\times10^{18}$
	45-35	1·850*	11·26	
	55-45	1·772*	10·47	
Sec-Hexyl alcohol	35-25	2·068*	13·26	$1·5\times10^{18}$
	,,	2·127	13·77	$9·3\times10^{18}$
	,,	2·079	13·36	$2·0\times10^{18}$
	45-35	1·975*	12·42	
	55-45	1·926*	11·96	
Capryl alcohol	35-25	2·286*	15·09	$8·7\times10^{21}$
	,,	2·341	15·52	$3·7\times10^{22}$
	,,	2·250	14·80	
	,,	2·363	15·69	$1·5\times10^{22}$
	45-35	1·398*	6·12	

Similar oxidation reaction with the aldehydes, such as acetaldehyde, n-butyraldehyde and iso-butyraldehyde by chromic acid in presence of H^+ions obtained from perchloric acid has also been studied under constant ionic concentration. The results obtained are given below :—

TABLE III

Oxidation of aldehydes : Order of the reaction

Aldehyde	Reactant with respect to which order has been determined	Concentration range	Order	Total Order
Acetaldehyde	Chromic acid	0·01 - 0·001	1	
	Acetaldehyde	0·1935 - 0·03871	0·87-1.09	
	H^+	0·03204 -0·02136	1·74	4 at low H^+ conc.
		0·3182 - 0·02136	1·87-1·96	4 at higher H^+ conc.
n-butyral-dehyde	Chromic acid	0·1 - 0·001	1	
	n-butyraldehyde	0·2253 - 0·04506	1·27-·84	
	H^+	0·03168 - 0·01056	1·44-1·13	3 at low H^+ conc.
		0·2112 - 0·1056	1·5-1·78	4 at higher H^+ conc.
iso-butyral-dehyde	Chromic acid	0·01 - 0·0002	1	
	iso-butyral dehyde	0·1075 - 0·02143	1·05 - ·93	
	H^+	0·05834 - 0·01167	6·96 - 1·33	3 at low H^+ conc.

The temperature coefficients, energy of activation and frequency factors have been found out and are given in table IV

TABLE IV

Oxidation of aldehydes by chromic acid : Temperature coefficients, energy of activation and frequency factors

Aldehyde	Temp. range °C	Temp. Coeff.	E K. cals.	A.
Acetaldehyde	35-25	1·659*	9·18	$3·4 \times 10^{11}$
	,,	1·649	9·13	$2·9 \times 10^{11}$
	,,	1·651	9·15	$6·9 \times 10^{11}$
	45-35	1·52*	7·64	..
	55-45	1·40*	6·14	..
n-Butyraldehyde	35-25	1·77*	10·42	$1·6 \times 10^{14}$
	,,	1·78	10·56	$3·5 \times 10^{14}$
	55-45	1·66	9·24	..
iso-Butyraldehyde	35-25	2·82*	18·91	$1·1 \times 10^{-28}$
	,,	2·99	19·99	$3·5 \times 10^{29}$
	,,	2·93	19·62	$1·9 \times 10^{9}$
	55-45	2·04	13·03	..

General discussion on the temperature coefficients

Dhar (Z anorg. Chem. 128, 218, 1923) has given the following average values for the temperature coefficients of chemical reactions

Unimolecular reactions	4·1
Bimolecular reactions	3·42
Termolecular reactions	2·02
Quadrimolecular reactions	1·79

Except the oxidation of iso-butyraldehyde, all the reactions studied here are quadrimolecular at higher H^+ ion concentration. The temperature coefficient of the oxidation of iso-butyraldehyde indicates a termolecular reaction. We notice here that the temperature coefficient is higher, the smaller is the order of the reaction according to von Halban-Dhar rule.

It must be pointed out that the total order of the reaction in chromic acid oxidation only conforms with the result obtained by a study of temperature coefficient, if the order with respect to H^+ ion is taken into consideration. Again in these reactions the temperature coefficients and the energies of activation decrease with increase of temperature. This again is in accordance with the von Halban-Dhar rule.

The frequency factors for the oxidation of alcohols, except for capryl alcohol are constant within a factor of about 10. For similar reactions involving homologous series of reactants, the frequency factors usually remain constant (Moelwyn Hughes Trans. Faraday Soc. 115, 167, 1949). The frequency factors for the oxidation of the aldehydes vary very much. Probably there are some other factors which affect the frequency factors in these reactions.

Recently a great deal of work has been done on an important aspect of chemical reactions in solutions, viz. the influence of substituents on the rate of reaction of a parent substance. A substituent influences the reactivity of a parent compound by altering the electron density at the seat of reation. Reactions which are favoured by an increase in electron density at a certain position in the molecule will be favoured by substituents which increase the electron density at that point and vice versa. Two homologous series have been taken here to get information on the effect of substituents on reaction rate.

The velocity constants with respect to chromic acid have been determined for all the reactions at 35° C and 45° C for the same concentrations of the reactants.

The results obtained are given below :—

TABLE V

	Substance	Conc. M	k·35° $\times 10^2$	k·45° $\times 10^2$	S-So	F-Fo	E-Eo
1.	Iso-Propyl alcohol*	0·1	0·1856	0·3866	0·0	0·0	0.0
2.	n-Propyl alcohol	0·1	0·2157	0·3782	-10·65	-23·2	-2508
3.	n-Butyl alcohol	0·1	0·3379	0·6105	-6·875	-316·2	-2792
4.	iso-Butyl alcohol	0·1	0·2676	0·4768	-9·23	-164·5	-3068
5.	sec-Buty alcohol	0·1	0·2924	0·5765	-2·6	-261·3	-1078
6.	sec-Hexyl alcohol	0·1	0·4957	0·92995	-6·7	-571.4	-2048
7.	n-Butyraldehyde	0·1	1·949	3·503	-4·6	-141.1	-2888
8.	Acetaldehyde	0·07741	1·529	2·379	-10·83	-600·8	-4001
	(iso-Propyl alcohol)	,,	0·5144	0·9820			
9.	iso-Butyraldehyde	0·05	3·998	9·154	+12·7	-166.2	+2301
	(iso-Propyl alcohol)	,,	3·3050	0·6208			

*Taken as standard for calculating F, S and E of other substances.

To obtain the above table the following equations have been utilised to calculate relative free energy, entropy and energy of activation :

$$\triangle F - \triangle Fo = -(RT \ln K'/Ko')$$

$$\triangle S - \triangle So = \frac{d}{dt}(RT \ln K'/Ko')$$

$$\triangle E - \triangle Eo = RT^2(\ln K'/Ko')$$

Here iso-propyl alcohol has been taken as the standard and $\triangle F$, $\triangle S$ and $\triangle E$ refer to the free energy, entropy and energy of activation of the alcohols and the subscript 0 refers to the values of the isopropyl alcohol.

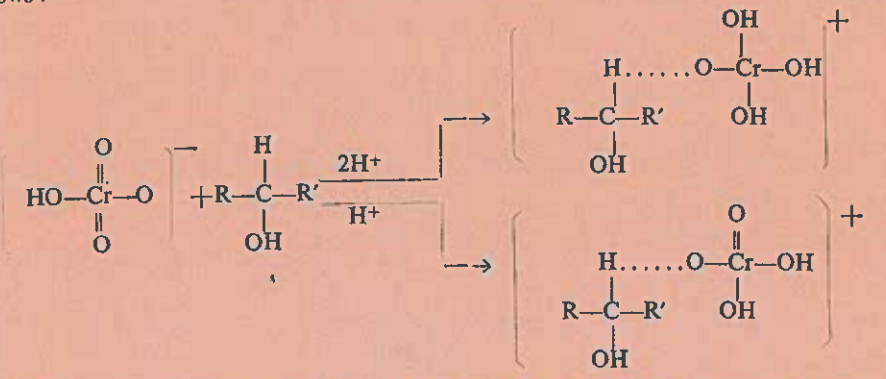
Considering the alcohols, the methyl group has the general effect of decreasing the energy of activation. This has been explained on the basis of the electron repelling effect of the methyl group. In these reactions the attraction between the two reactants is the important factor in determining the energy of activation (Hinshelwood, Laider and Timm J. C. S. 848, 1938) whereas in the case of the two alcohols n-propyl alcohol and sec-butyl alcohol, the substitution of a methyl group for a H atom in the α position, has the effect of increasing the energy of activation. It is difficult to explain this effect except by considering here that the ionisation of the bond between the OH and the rest of the molecule probably determins the energy of activation.

According to the entropy of activation values the rigidity of the compounds studied is probably in the order given below :—

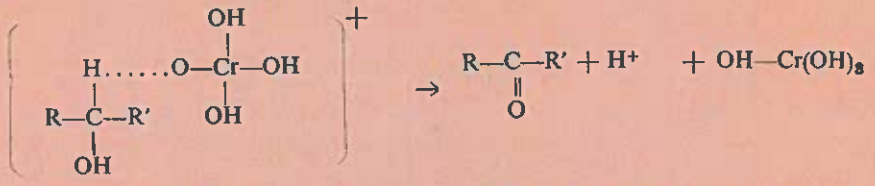
Iso-propyl alcohol > sec-butyl alcohol > sec-hexyl alcohol > n-butyl alcohol > iso-butyl alcohol > n-propyl alcohol among the alcohols and iso-butyraldehyde > acetaldehyde > n-butraldehyde among the aldehydes. The free energies of activation show a very good parallelism with the rates of reaction.

The results obtained both from a study of chemical kinetics and the temperature coefficients show that in the oxidation of alcohols studied here one molecule of the acid chromate ion, one molecule of the alcohol and either one or two ions of H are involved in the rate determining process.

Therefore the formation of the intermediate complex may be represented as follows :—



The intermediate complex then decomposes to form the ketone or aldehyde through the oxonium compound.



In the oxidation of Mn^{++} ions to Mn^{++++} by chromic acid induced by alcohols, it has been found out that the induction factor is 0.5. In all induced oxdations involving chromic acid as actor where induction factor is 0.5 it has been shown that the intermediate ion is tetravalent chromium. From the above results, the mechanism of chromic acid oxidation may be formulated as follows :—

In absence of the Mn salt

$$HCrO_4^- + R{-}CHOH{-}R' \rightarrow Cr^4 + R{-}CO{-}R' \quad (a)$$

$$2Cr^4 + R{-}CHOH{-}R' \rightarrow Cr^3 + R{-}CO{-}R' \quad (b)$$

or if Cr^5 and Cr^3 are also supposed to be formed in the reaction then we have

$$Cr^4 + R{-}CHOH{-}R' \rightarrow Cr^3 + R{-}CO{-}R' \quad (c)$$

$$Cr^2 + Cr^6 \rightarrow Cr^3 + Cr^5 \quad (d)$$

$$Cr^5 + R{-}CHOH{-}R' \rightarrow Cr^3 + R{-}CO{-}R' \quad (e)$$

In the presence of $MnSO_4$ the following mechanism is suggested

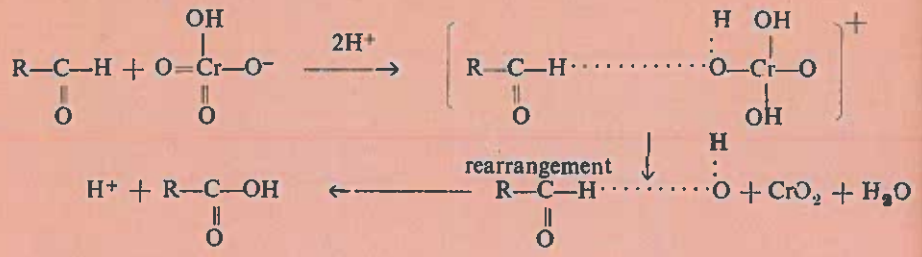
$$HCrO_4^- + R{-}CHOH{-}R' \rightarrow Cr^4 + R{-}CO{-}R'$$

$$Cr^3 + Mn^2 \rightarrow Cr^3 + Mn^3$$

$$2Mn^3 + 2H_2O \rightarrow MnO_2 + Mn^2 + 4H^+$$

The reactions a, b, c and d produces the intermediary Cr^5 and Cr^3 whereas for only a and b to occur this supposition is not necessary. Hence according to a and b, the induction factor 0.5 is acceptable.

However in the case of the oxidation of aldehydes, the reaction appears to be a very complicated one and unless more work is undertaken to find out the intermediate compounds formed during the reduction of chromic acid, a complete picture of the mechanism of chromic acid oxidaton of these aldehydes cannot be given as the valency of the intermediary compounds could not be determined with accuracy. Hence the suggestions are tentative only pending, further work.



The mechanism presented here is different from the mechanism of the oxidation of alcohol by bromate ions and the mechanism of the oxidation of aldehydes in the gaseous state, but appears to be similar to the oxidation of alcohols and aldehydes, by selenium dioxide. The conclusions arrived at in the present investigations are based upon the experimental evidence obtained by Shri Varkey Antony in my laboratory. My sincere thanks are due to him for this.

MARCH OF BIOLOGY

PRESIDENTIAL ADDRESS

DELIVERED AT

The Biological Sciences Section during The Silver Jubilee Session of The National Academy of Sciences, India on 27th December, 1955 at Lucknow

By

DR. A. C. JOSHI, D. Sc., F. N. I., F. N. A. Sc.,

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I am much obliged to the Council of National Academy of Sciences for inviting me to preside over the Biological Section on the occasion of its Silver Jubilee celebrations. Considering the fact that I am no longer a working scientist, I greatly appreciate this honour.

I have special interest in the National Academy of Sciences because it was founded twenty-five years ago in the same year at Allahabad that I attended the first Session of the Indian Science Congress and began my scientific career. During the twentyfive years, that have passed since then, big developments have taken place in almost every branch of science. It has appeared, consequently appropriate to me to survey to-day briefly some of the outstanding advances among the biological sciences which affect either human thought or human welfare.

The greatest contribution of biology in the last century was the establishment of the theory of organic evolution. This still occupies a central place in many departments of the subject. You may all be knowing what a great stir the publication of 'Origin of Species' in 1859 caused. It aroused a big controversy and met with strong opposition from the church. Even the bringing of this book in some homes was considered indecent, and youngmen were often punished by their parents for reading the works of Charles Darwin. In spite of this opposition of the church and many laymen, theory of organic evolution continued to win supporters. By the end of the last century, evolution as a historical process was established as thoroughly as science can establish

a fact witnessed by no human eye. No rational person, whether biologist or non-biologist, disputes to-day the occurrence of organic evolution and the gradual change in form among plants and animals since the dawn of life on this planet. The study of fossils, which was taken up with great zeal both by botanists and zoologists during the last century, has given us authentic pictures of the fauna and flora of the earth during the different geological epochs. Such studies have been pursued actively even during the last twenty-five years and many gaps in our knowledge of ancient forms of life have been filled. Looking back over this period, one feels proud of the fact that this country did not lag behind other nations in studies in this field. The Institute of Paleobotany, which is located in Lucknow, is a tribute to the work that was done in this city under the leadership of the late Professor Birbal Sahni. It has been a tragedy of Indian Science that he died so young and is not amongst us to-day. Had he been alive, I am sure, he would have been elected to preside over this momentous session of the National Academy of Sciences.

While the doctrine of organic evolution was well established by the end of last century in the sense that no informed person had any doubt that evolution had occurred, yet until recently, we had hardly any exact knowledge about the mechanism of evolution or the change of one species into another. Writing as late as 1922, Bateson said : "In dim outline evolution is evident enough. But that particular and essential bit of the theory of evolution, which is concerned with the origin and nature of species, remains utterly mysterious." During the thirty years or so, that have passed since this statement was made, in my opinion, the greatest advance in biology is that we are now able to see to a considerable extent the mechanism of evolutionary change. We know now something of the factors which have played a leading role in this process and of the pattern of evolution among different kinds of organisms. Nobody is yet audacious enough to say that we have obtained full knowledge of the subject, but we are sure enough in the process of discovering the intricacies of the mechanism of evolution and are hopeful that in the not distant future, we shall have full knowledge of the various factors which lead to the transformation of one kind of animal or plant into a different species.

This knowledge has been obtained largely through the development of sciences of genetics and cytology. One striking result of these studies has been the emergence once again, after a short period of eclipse, of natural selection as an important force in the process of evolution. This is surprising because the first big attacks on the theory of natural selection were made by the geneticists like Bateson, De Vries and Morgan. The change in outlook has also come about from the researches of geneticists. Muller, Sturtevant and Timofeeff-Ressovsky are some of the great names in this line as well as satistical-minded workers such as Haldane, Fisher and Sewall Wright. A striking illustration of the rebirth of Darwinsim is afforded by T. H. Morgan. After having

been one of the most vehement critics of selectionist doctrine, he has, as a result of recent work in genetics, become an upholder of the Darwinian point of view.

Another result of the recent studies has been to establish that the mechanism of evolution is not exactly the same among all plants and animals. It varies among different groups of organisms, and in the origin of new species, selection, isolation and intrinsic factors, including hybridization, are equally important. None of them is more important than the rest and all are equally necessary. Cytological studies, coupled with experimental genetics, have established that gene changes, i.e., mutations are the most obvious source of evolutionary transformations and of diversity in general. Next we have changes of a mechanical kind in the chromosomes which involve considerable rearrangements of the genes. It has been proved in many cases that such rearrangements may often bring about changes in the functioning of the genes themselves (position effects). Reduplications of whole chromosome sets (autopolyploidy), combining chromosome complements of different species to produce another new species (allopolyploidy), polysomy, etc., have been found to play an important evolutionary role among plants. Yet such changes in the genes or chromosomes alone have been shown to be incapable of producing directional change or of overriding the effects of selection. The two processes are complementary. Their interaction is as necessary for the process of evolution as hydrogen and water are necessary for the production of water.

With regard to selection, it has been established that it may take place in many different forms and achieve different results according to conditions under which it operates. Selection in small isolated groups has been found to be different in its results from selection in large continuous groups. The intensity of selection also differs under different conditions. Isolation may reduce the intensity of selection while other ecological peculiarities of the environment may increase its effect. Selection acts quite differently at different points in the cycle of abundance of species with periodic fluctuations in numbers. Quite small changes in population density or in environmental conditions may reverse the selective balance. The use of statistical methods has given a firm deductive basis for the selection theory. It is not necessary to go into details. One can, however, safely say that selection as a force in organic evolution, which was often doubted twenty-five years ago, is now well-established, and the views of Charles Darwin, which he expressed a hundred years ago—have been fairly vindicated. The table reproduced below after Huxley gives an outline of the process of evolution among different organisms :

Mode of Speciation	Isolation of Groups	Separation of new species	Visible differentiation	Barriers to fertility
I. Successional ..	I. Temporal	gradual	gradual	..
II. Divergent	2. Spatial			
	(a) large-scale : geographical	gradual	gradual	consequential
	(b) medium-scale : ecological	gradual	gradual ; distinctive characters, frequent.	largely selective
	(c) small-scale : biological (biological races)		gradual ; slight.	
	3. Genetic			
	(a) genic	abrupt	gradual	initial
	(b) asexual segregation	abrupt	abrupt	initial
	(c) segmental interchange.	gradual	gradual, slight	partly initial.
	(d) inversion	gradual	gradual, slight.	,,
	(e) autopolyploidy	gradual or abrupt	mainly gradual.	initial
III. Convergent	(f) allopolyploidy.	abrupt	initially abrupt.	initial
	(g) aneuploidy (secondary polyploidy).	abrupt	,,	,,
IV. Reticulate				
(i) Convergent-divergent (polyploid-complexes)	genetic, various	abrupt	abrupt	partly absent.
(ii) recombinational	geographical, reduced by migration	not found	increased variability	absent

Twenty-five years ago the gene theory of heredity had been established, but hardly anyone knew anything regarding the structure of gene or the composition of chromosome. At that time we also knew next to nothing about how the gene acts in controlling development. The situation is now completely changed. The science of physiological genetics is well established and we have obtained a fair insight both into the composition as well as the manner in which a gene acts.

Genes have been shown to be built up of proteins and nucleic acids. The study of viruses, which has also been actively pursued during the preceeding quarter century, has established a close similarity between them and the genes. Groups of scientists working in the Universities of Washington, St. Louis and California have recently torn apart the virus of tobacco mosaic and put its parts together again to restore the infective capacity. Nucleic acids and proteins prepared by splitting this virus when rubbed independently on tobacco leaves have been found to have no effect. However, when the fragments of nucleic acid are combined with the proteins and this composition is rubbed on the leaves of the tobacco plant, they produce the disease. Viruses have been, for some time, described as a connecting link between the living and the non-living. The recent work appears to have completely smashed the barrier between life and lifeless objects. Possibility has been created for synthesizing new forms of viruses. This means creating life itself in the laboratory.

Another great achievement of the last few years closely related to the science of genetics is the discovery of chemical and other treatments which enable one to double the number of chromosomes in plants. The most important among them is colchicine. With its application it has become possible not only to produce autopolyploids but also allopolyploids from crosses of different varieties and species of plants. Taken along with the perfection of methods for artificial culturing of embryos, this has opened up possibility of producing fertile plants from wide crosses. The results are not only of theoretical interest, but open up immense possibilities of producing new varieties of crop plants.

Progress in the sciences of genetics and cytology and increased knowledge about the mechanism of speciation that has been acquired during the last three decades has completely changed the outlook in several other branches of biology. Taxonomy well illustrates this. From a rather narrow subject, on the whole empirical and lacking in unifying principles, taxonomy has became to-day a most interesting field for synthesizing biological knowledge. It encompasses within itself now almost every other branch. From a neglected subject, which was very often left to amateurs, taxonomy has come into its own, and an increasing number of workers are taking to it. We find expression of this fact in our own country from the big expansion of botanical and zoological surveys, which is being undertaken by the Ministry of Natural Resources and Scientific Research. Taxonomic studies prosecuted with increasing vigour in

European countries, U. S. A., and Japan have illumined the history and status of many economic plants, which, in turn, has revolutionized plant breeding programmes.

From such co-ordinated studies of the systematics and genetics of crop plants, especially due to the labours of Vavilov and his associates, has been established another great principle, the law of homologous variation. It was first worked out of cereals, but has been found to be widely applicable. Homologous variations had been noticed even before Vavilov's time. He, however, gave such facts a new significance. Now the law of homologous variation is that variations (sports or mutations) of the same kind can be found in plant after plant if we make a thorough enough search for them. There are, thus, the red-leaved varieties of many trees. There are also the weeping trees and the dwarfs. Among the cereals, Vavilov discovered that if you find a peculiar form of one cereal it could nearly always be discovered in others. From such elementary observations, he went on to a most amazing discovery. He found a geographical regularity in the distribution of these varied forms of the different cereals. If a certain area was found to have a large number of peculiar types of one crop, one could predict that it would be a centre of diversity for several other crops as well. One could even predict the kind of variation which could be found in such centres of diversity. From wide explorations, Vavilov and his colleagues established the fact that a great bulk of variation in our crop plants, and to some extent, even among the weeds, is concentrated in about half a dozen small areas. In these few centres there is much more variability of the crop plants than in all the rest of the world put together.

These discoveries have had a revolutionary effect on the practice of plant breeding. Genetical studies of a few plants like sweet pea and maize had already made it possible for any-one to order a plant of his choice. The work of the Russian botanists has established that we could breed plants for any kind of climate and region. One had only to search widely and thoroughly enough to collect the different types of variations and then combine them with other desirable characters. Previously the concept was that particular plants or trees could be grown only in certain regions with a certain amount of rainfall, temperature, etc., and their cultivation in other regions with a different climate was considered impossible. The plant breeder no longer believes in this postulate. Given time he is prepared to breed plants for any type of climate. Taking into consideration the fact that we have now also the means for producing mutations artificially by exposing plants and animals to X-rays and other kinds of radiations, and inducing polyploidy by colchicine and other treatments, the scope of plant breeding has been widened immensely. Mankind can now look forward to a large variety of crops to meet his growing requirements.

Similar advances in biological sciences have been made in other departments in plant physiology, animal physiology, ecology and even in such old departments as morphology. The biochemist is almost on the verge of unravelling the mysteries of

photosynthesis. Studies of photo-synthesis among algae like *Chlorella* have opened up before us the possibility of synthesizing food over a given area of the earth several times more than what is achieved by the ordinary crop plants. Thus considerable possibilities of increasing our food supplies from the energy of the sun have been opened up. Even with our rapidly increasing population, mankind should have no fear of food shortage for a long time to come.

The discoveries in the realm of response of plants to the relative length of day and night, temperature, etc., have enabled us to further control the growth of plants and extend their cultivation to areas where they could not be grown otherwise.

The studies of the interactions of fungi and bacteria which began some time ago have now flowered into the science of anti-biotics which is revolutionizing the practice of medicine.

Investigations in the field of plant hormones and manufacture of synthetic hormones are affecting profoundly the production of fruits and several vegetable crops. Synthetic hormones have been found to be valuable in several ways. Under conditions unfavourable for pollination dilute solutions can be sprayed on flowers to induce the setting of the fruit and subsequent production of a full crop, which will of course be largely seedless. This has its greatest application in commercial tomato growing and is being extended to other fruits such as figs and grapes. Synthetic auxin sprays can also be used to retard the abscission, and fall of maturing fruit, such as apple, thereby reducing damage and loss and also allowing greater flexibility in the planning of harvesting operations. An incidental advantage is that the post-harvest ripening and quality of the fruit may be improved. The effect of synthetic auxins on flowering has been fully exploited in the pineapple industry, where the da te of fruiting can be precisely determined by carefully timed sprays of very dilute *a*-n a phthylacetic acid solutions. This completely obviates the difficulties of harvesting and marketing previously resulting from the normal random spread of fruiting.

About the beginning of the 17th century, the philosopher scientist, Bacon made a prediction about what could be expected from science, especially with respect to the welfare of man. A tabulated account of Bacon's expectations, and the results that have been achieved to-day was prepared by F. Sherwood Taylor some years ago. It is reproduced below :—

Bacon's Programme	*Our Results*
The Prolongation of Life.	.. Expectation of life more than doubled, perhaps, trebled, since his time.
The Restitution of Youth in some Degree.	'Monkey-gland' (c. 1920) : sex-hormones synthesised (1938).

The Retardation of Age ..	Very marked ; largely owing to reduction of chronic septic conditions, modern dentistry, cosmetics, and contraceptives.
The Curing of Diseases counted Incurable.	The wholly incurable diseases are to-day a minority.
The Mitigation of Pain ..	Aspirin : local anaesthetic's relief of intractable pain by nerve-surgery.
More Easie and less Loathsome Purgins ..	Introduction of phenolphathalein, 'fruit salts,' etc. and the abandonment of violent purging in Medicine.
The Encreasing of strength and activity.	Stature of children (and of the race generally) greatly increased by better feeding and more exercise.
The Encreasing of Ability to Suffer Torture or pain.	Anaesthetics and Hypnotism.
The altering of Complexions*and Fatness and Lean-ness.	Hormone therapy ; administering of thyroid extract or drugs to influence metabolism.
The altering of Statures ..	Administration of pituitary extract can produce giants. Thyroid extract makes cretinous dwarfs normal.
The altering of Features ..	Plastic surgery.
The Encreasing and Exhalting on Intellectual Parts.	Little progress here, save in so far as Education has been scientifically organised.
Version of Bodies into other Bodies. ..	The myriad marvels of organic chemistry : silk from wood, dyes from coal.
Making of new Species. ..	Genetic experiments : especially influence of X-Rays on the fruitfly *Drosophila*.

*Complex in Bacon's day meant "constitution" or "habit of body", not the condition of the skin.

Transplanting of one species into another.	Turkey-legs have been grafted into chicken embryos.
Instruments of Destruction as of war and Poison.	High esplosive, machine guns poison-gas.
Exhilaration of the spirits and putting them in good disposition.	A discovery still urgently required.
Force of the Imagination either upon another Body or upon the body itself.	Psychological treatment of neuroses and hysterical symptoms.
Acceleration of time in Maturations and Clarifications.	Artifical ripening of spirits.
Acceleration of Putrefaction. ..	The septic tanks : compounds such as "Adco" for converting green stuff into manure.
Acceleration of decoction. ..	Use of high-pressure boilers in large-scale cookery, etc.
Acceleration of Germination. ..	Little, if any, advance.
Making rich composts for the Earth. ..	The fertiliser industry.
Impressions of the Air and raising of tempests.	Still not possible.
Great Alteration of Induration, Emollition, etc.	Notions not shared by modern science.
Turning Crude and Watery Substances into Oily and Unctuous substances.	Synthetic oils from coke and water.
Drawing of new Foods out of Substances not now in use.	Glucose from starch and cellulose. Margarine from fish oils, etc.
Making new Threds for Apparel and New Stuffs such as are Paper, Glass, etc.	Artificial silk, bakelite, celluloid, etc.
Natural Divinations ..	Weather forecasts.
Deceptions of the Senses. ..	Scientific conjuring. The stereoscope.
Greater Pleasures of the Senses. ..	Cinema, radio, new musical instruments, new dyes.
Artificial Minerals and Cements ..	Artificial stone, Portland cement, cultured pearls and synthetic jewels.

It appears that we have today achieved almost all that Bacon proposed. There is only one noteworthy departure from the Bacon's prediction and that is that Bacon never imagined the utilization of mechanical power and the acceleration of transport and communications which have been achieved by modern science.

Speaking some years ago before an annual meeting of the Indian Botanical Society I drew attention to the paradoxical fact that man's interest in nature has been in proportion to the distance between him and the subject of his study. Objects furtherest removed from him have always exercised a strong fascination on his mind. The sun, moon and stars attracted his attention long ago in pre-historic times. On the other hand, he has shown even in recent times much less inclination to pursue the science concerned with the study of living organisms. This lop-sided development of science has been unfortunate, for the future welfare and happiness of mankind are ultimately bound up with the pursuit and cultivation of the biological sciences. As Sir Henry Tizard said some years ago, "Whatever new comforts and luxuries may be provided in future by the advancement of physical science, it is on the development of biological sciences that the peace and prosperity of the world will largely depend." When world's resources of coal, oil, iron. etc. are all exhausted man will have to turn to the plants to meet all his wants for the green leaf will always remain the most important machine for capturing the sun's energy and converting it to a form which can be utilized by other living organisms.

This fact is being increasingly appreciated the world over. The neglect from which biology suffered in the past is being realised, and the outlook for this science to-day can be regarded with a good deal of optimism. The various authorities in our country as also in others are waking up to the need for promoting biological studies. On the other hand, many interesting fields for research in different branches of biology are opening up and numerous problems exist for any intelligent person to apply his mind. No period in our history has been full of so stimulating and exciting possibilities as the present. If we could rise to the level of scholarship that could do justice to this period of discovery, the golden age of biology may not be far off.

PHYSICAL SCIENCES SECTION

ABSTRACTS OF PAPERS

A SIMPLE THEORETICAL TREATMENT OF ALKALI HALIDE GAS MOLECULES

By PROF. LINUS PAULING

California Institute of Technology, Pasadena (U. S. A.)

A simple treatment based upon use of Born expression for the repulsive potential and complete neglect of polarisation of the ions has been described in this paper. The theoretical treatment leads to values of the equilibrium internuclear distance, vibrational frequency and enthalpy of formation of diatomic gas molecules of alkali halides in reasonably good agreement with experiment for those molecules that has been investigated by microwave spectroscopy.

REACTIONS WITH LITHIUM—ALUMINIUM—HYDRIDE IN ORGANIC CHEMISTRY

By P. KARRER,

University of Zurich, Zurich (Switzerland)

This review describes the application of lithium-aluminium-hydride as a reducing substance in various organic reactions. Compounds that previously could be synthesized only with difficulty can now be made with ease. Numerous entirely new compounds can be made.

SUBSPACES OF A SPACE WITH TORSION

By KAMLA DEVI SINGH

Department of Mathematics, University of Delhi

Let us consider a n-dimensional space V_n with coordinates x^i $(i=1,2,\ldots n)$ and fundamental metric form $g_{ij}\,dx^i\,dx^j$ immersed in a m-dimensional space V_m with coordinates y_α $(\alpha=1, 2,\ldots,m,)$ and metric form $a_{\alpha\beta}dy^\alpha\,dy^\beta$.

We assume that all covariant and contravariant indices have a definate signature and define the tensor derivative as follows

$$T\begin{matrix}a_1\ a_2..a_p\\ +\ -\ -\\ \beta_1\ \beta_2..\beta_q;\delta\\ -\ -\ +\end{matrix} = \frac{\delta T\begin{matrix}a_1..ap\\ \beta_1..\beta_q\end{matrix}}{y\delta} + T\begin{matrix}\epsilon a_2..a_p\\ \beta_1..\beta_q\end{matrix}\Gamma\begin{matrix}a_1\\ \epsilon\delta\end{matrix} + T\begin{matrix}a_1\epsilon..a_p\\ \beta_1..\beta_q\end{matrix}\Gamma\begin{matrix}a_2\\ \delta\epsilon\end{matrix}$$

$$.....+T\begin{matrix}a_1..\epsilon\\ \beta_1..\beta_q\end{matrix}\Gamma\begin{matrix}a_p\\ \delta\epsilon\end{matrix} - T\begin{matrix}a_p\ .a_p\\ \gamma\beta_2..\beta_q\end{matrix}\Gamma\begin{matrix}\gamma\\ \delta\beta_1\end{matrix} -$$

$$T\begin{matrix}a_1..a_p\\ \beta_1\gamma..\beta_q\end{matrix}\Gamma\begin{matrix}\gamma\\ \delta\beta_2\end{matrix} - .... - \Gamma\begin{matrix}a_1..a_p\\ \beta_1..\gamma\end{matrix}\Gamma\begin{matrix}\gamma\\ \beta_q\delta\end{matrix}$$

where semi-colon (;) followed by an index denotes tensor derivative and $\Gamma\begin{matrix}\gamma\\ \beta\gamma\end{matrix}$ are the connections for V_m given by the relation

$$a\ \underline{a\beta}\ ; v \equiv \frac{\partial a a\beta}{\partial y v} + \epsilon\beta\ \Gamma\begin{matrix}\epsilon\\ \gamma v\end{matrix} - a a\ \Gamma\begin{matrix}e\\ v\beta\end{matrix} = O$$

In this paper subspaces are studied and some results are deduced.

FORMATION OF COMPLEX COMPOUNDS BETWEEN CADMIUM HALIDES AND ALKALI HALIDES PART III

By K. G. KAIMAL *and* A. K. BHATTACHARYA,
Department of Chemistry, University of Saugar

The formation of complex compounds between cadmium chloride and potassium chloride has been studied by various physico-Chemical methods. The graphs indicate the formation of the Compounds : $CdCl_2$ 4KCl, $CdCl_2$ 2KCl, $2CdCl_2$ 3KCl, $CdCl_2$ KCl, $3CdCl_2$ KCl, $3CdCl_2$ 2KCl and $2CdCl_2$ KCl

INFLUENCE OF CHEMICAL CONSTITUTION ON THE ROTATORY POWERS OF OPTICALLY ACTIVE COMPOUNDS. PART. II

By MAGHAR SINGH MANHAS *and* SAKTI PRASAD BANERJI
Department of Chemistry, University of Saugar

In this paper the hydrazones of d-camphor-beta-sulphonic acid with phenyl-, o-nitrophenyl-, p-nitrophenyl and 2 : 4 dinitrophenyl hydrazines have been studied and their rotatary powers studied. It is found that all these hydrazones are laevorotatory in character. The rotatory dispersion in various solvents and the effect of introducing nitro-group in the molecule in different positions on its rotatory power have also been studied.

A CHARACTERISTIC DIFFERENCE BETWEEN A KAEHLER C_n OF COMPLEX DIMENSIONS n AND REAL DIMENSIONS 2n AND A RIEMANNIAN V_{2n} OF REAL DIMENSIONS 2n.

By MISS GITA HALDAR *and* RAM BEHARI
Department of Mathematics, University of Delhi

The number of orthogonal ennuples in a Riemannian Vn has been obtained by a new method. It has been shown that the number of orthogonal ennuples in a Riemannian V_{2n}, is greater than the number of orthogonal ennuples in a Kaehler Cn, so that no isomorphism can be set up between a Kaehler C_n and the Riemannian V_{2n}.

HYPERSURFACES OF A KAEHLER MANIFOLD.

By S. C. SAXENA *and* RAM BEHARI
Department of Mathematics, University of Delhi

Properities of curves in a hypersurface of a Kaehler manifold have been studied and the equations of Gauss and Codazzi have been obtained.

ROLE OF ENERGY—RICH MATERIALS AS CONSERVATORS IN PRESENCE OF NITROGENOUS FERTILIZERS IN SAGAR SOIL

By O. N. TRIPATHI
Department of Chemistry, University of Saugar

In this paper the extent to which urea decomposes in a period of 210 days in sunlight has been discussed with the help of photochemical theory. The loss has been effectively checked when energy-rich materials like wheat-straw, lignite, sugar candy and molasses were added to the soil containing urea.

KINETICS OF THE REACTION BETWEEN TRIVALENT MANGANESE AND OXALATE

By DHIRENDRA NATH CHAKRAVARTY *and* SATYESHWAR GHOSH
Department of Chemistry, University of Allahabad

Trivalent manganese has been produced by the interaction of freshly precipitated hydrous manganese dixoide and potassium acid oxalate. It is noted that with a large excess of oxalate, manganese dioxide quickly dissolves yielding the red coloured solution of the complex anion, mangani-oxalate. This complex anion is then reduced to divalent managanese which has a measurable velocity. The trivalent manganese left over at different intervals of time has been estimated iodometrically and the reaction rate has been found to be of the unimolecular order with respect to trivalent manganese but is independent of the oxalate concentration. On the other hand the high concentration of oxalate slightly decreases the reaction rate. The temperature coefficient is found to be 3.0 between the temperatures 25° C and 35° C.

A mechanism of the reduction of trivalent manganese has been suggested and it has been shown that the rate determining process is the production of free OH radical in solution from trivalent manganese according to the scheme

$$Mn^{+++} + H_2O = Mn^{++} + OH + H^+ \qquad (1)$$

OH thus generated reacts with oxalate as

$$OH + C_2O_4^{--} = OH^- + C_2O_4^- \quad (2)$$

which is followed by

$$C_2O_4^- + OH = 2CO_2 + OH^- \quad (3)$$

The reactions given in (2) and (3) involves free radicals and are fast. Hence the reaction rate depends on (1). Further the concentration of trivalent manganese depends on the stability constant of the mangani-oxalate ion. Hence larger concentrations of oxalate depress the dissociation of the complex anion and therefore the amount of trivalent manganese available for the production of OH by (1). This explains the decrease in the reaction rate with the oxalate ion concentration.

Our experimental results regarding the order of this chemical changes completely rules out the possibility of the reaction according to

$$2Mn^{+++} + C_2O_4^{--} = 2Mn^{+} + CO_2.$$

STUDY ON THE OXIDATION OF BIVALENT MANGANESE BY HEXAVALENT CHROMIUM

By DHIRENDRA NATH CHAKRAVARTY *and* SATYESHWAR GHOSH

Department of Chemistry, University of Allahabad

The formation of highervalent manganese specially trivalent, by the oxidation of divalent manganese by heptavalent or quadrivalent manganese compounds such as permanganate and manganese dioxide has been described by several workers. This paper deals with the oxidation of bivalent manganse to higher valencies, effected by the hexavalent chromium *i.e.* dichromate. It been shown that the oxidation of divalent manganese to trivalent stage is possible within the limits of definite concentrations of the acid solutions. For highly acid solutions the oxidation of bivalent manganese may proceed to permanganate stage. The changes have been followed by the use of a Klett Summerson's photoelectric colorimeter in the region between 6400-7000 A.

The oxidation of bivalent manganese from a mixture of .076 M manganous sulphate and .006 M of potassium dichromate in presence of 12N H_2SO_4 yields trivalent manganese. The results as calculated from colorimetric data shows the order to be unity with respect to dichromate.

REDUCTION OF MERCURIC CHLORIDE BY SOLUBLE OXALATE

By ASHIT KUMAR SINHA *and* SATYESHWAR GHOSH

Department of Chemistry, University of Allahabad

Dhar observed the reduction of mercuric chloride by soluble oxalates in dark induced by such oxidising agents a potassium permanganate, manganese dioxide and

potassium persulphate. Ghosh and co-workers for the first time showed that the reduction can also be affected in dark by using reducing agents such as sodium formate in very small concentrations capable of reducing mercuric chloride to negligible amount. This paper deals with the reduction of mercuric chloride by soluble oxalates in dark using bi-positive iron in very small concentration as inductor.

The rate of the reduction has been followed by estimating mercuric chloride volumetrically with potassium iodide. It is found that the rate of reduction does not follow any definite order. It has an induction period which is specially observable at about 5°C ; after which the reaction rate increases rapidly and then falls off. In no case the reduction goes to completion but the amount is always far greater than that can be accounted for by the presence of bipositive ion which is always present in very small quantities. The reaction rate and the percentage of reduction of mercuric chloride is found to increase with the increasing concentration of bipositive ion and oxalate present in the reaction mixture.

These results have been explained due to the generation of free radical OH in solution in coarse of the oxidation of the ferrous oxalate complex anion by the dissolved oxygen in solution. Completely oxygen free solution do not respond to reduction by the addition of bipositive ion. The hypothesis advanced here has been further substantiated from the observation that the mixtures of bipositive iron and oxalate left over for sometime loses its activity as an inductor appreciably. Further the chloride ions greatly suppress the activity of the inductor.

These results are therefore in agreement with the views of Haber and Wiess, suggesting the existence of free radicals in solution.

THE EFFECT OF CERTAIN SOLUBLE SALTS ON THE SYSTEMS OF SODIUM TUNGSTATE WITH ORGANIC ACIDS

By G. S. RAO *and* S. N. BANERJI

Department of Chemistry, University of Saugar

The authors have reported earlier the systems of sodium tungstate with organic acids. This paper records the effect of acetates, oxalates, tartarates and citrates on the systems.

pH CHANGES IN SAUGOR SOIL

By P. N. AWASTHI *and* A. K. BHATTACHARYA

Department of Chemistry, University of Saugar

The pH of the soil before manuring was high but on the addition of energy rich materials it showed a considerable fall after 8 months exposure to sun light. The cor-

responding pH change at different period was shown to be due to the soil particles, partly removing any action from solutions which get loosely attached to the soils. It was further argued that in the presence of hydrogen ions, the soil remains unsaturated and on the application of a neutral salt to such a soil with its hydrogen ions the solution became acidic for the simple reason that the ionic exchange occurred whereby hydrogen ions came into the solution.

CHROMATOGRAPHIC STUDY OF FERRICYANIDE : Rf VALUES WITH ETHANOL—WATER MIXTURE AS SOLVENT

By RAMA SHANKAR *and* ARUN K. DEY,

Departments of Chemistry, Jaswant College, Jodhpur and University of Allahabad

In this paper ascending filter paper method has been employed to determine the R_f values of ferricyanide using various water-ethanol mixtures as solvent. It was found when 100 per cent. ethanol was used the spot of ferricyanide did not move at all, *i.e.* the R_f value was equal to zero, and the value went on increasing as the proportion of water in the solvent mixture was raised. With 30% ethanol, the value and was 0.85, which tended to increase to unity on further decrease in the percentage of alcohol. It is concluded that a mixture of 60%. ethanol and 40% water is a suitable solvent for chromatographic study of ferricyanide, the R_f value being about 0.4 in this case.

STUDIES ON HYDROUS ZINC OXIDE PART V. HYDRATION OF THE PRECIPITATED OXIDE OBTAINED UNDER DIFFERENT CONDITIONS

By KALI CHARAN VARSHNEY *and* ARUN K. DEY

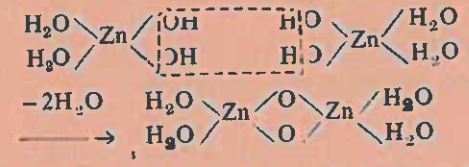
Departments of Chemistry, S. M. College, Chandausi and University of Allahabad

In a recent paper Shaw and Dey have advanced a hypothesis based on Inorganic Polymerisation to explain the variation in the properties of hydrous oxides precipitated under different conditions. In the previous parts of the present series we have studied the preparation and properties of hydrous oxide obtained under different conditions. In this paper we have described our results on the hydration of the precipitates obtained at different temperatures and also noted the effect of age on the hydration of the precipitated mass. It was found that, in general, the water associated diminished with the increase in temperaure of precipitation, and also growing age of the samples. The dimunition of associated water has been explained on the basis of Inorganic Polymerisation.

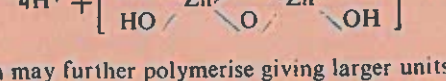
Zinc possesses a co-ordination number of four and on the addition of alkali to a zinc salt solution the precipitation occurs according to the following scheme :

$$[Zn(H_2O)]^{+2} + 2OH^- = [Zn(H_2O)_2(OH)_2]^0 + 2H_2O$$

The precipitated mass polymerises, losing water as follows :



The polymerised mass loses protons, due to the amphoterism of the oxide, according to the following :



and the anion may further polymerise giving larger units accompanied by loss of water. Evidently this phenomenon will be more pronounced when the precipitation is carried out at a high temperature.

COMPLEX SILVER CITRATE

By ANIL K. MUKHERJI *and* ARUN K. DEY

Department of Chemistry, University of Allahabad

The authors have carried out the conductometric study of various mixtures of silver nitrate-soluble citrate systems and have concluded complex formation from their results.

A NOTE ON PERIODIC CLASSIFICATION OF ELEMENTS

By P. B. MATHUR

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Recent trend in the direction of classifying the elements is to arrange them in sequence of electronic configuration of atoms. But the classifications fail when the question of arranging transitional and rare earth family elements come. It has been observed that if these elements are arranged in sequence of their atomic stucture, periodicity in the table breaks and if, on the other hand periodicity is maintained the structure sequence is not followed. Transitio nal and rare earth elements possessing more than one unsaturated orbits show structures which are altogether different from the true structure which is responsible for the various properties of these elements. The unsaturated orbits mutually interact and give finally a internally reacted atom.

The whole properties of the atom would depend upon the penential unstable structure of these elements and not on 'I.R. A.' In this paper general rules for obtaining penantial structure has been given and also this stucture for all transitional and rare earth elements have been obtained. It is then showed that when the elements are arranged on the basis of this stucture, they attain perfect periodicity in properties. The arrangement follow a Bi-planer system.

MECHANISM OF PHOTOGRAPHIC DEVELOPMENT BY PARAPHENYLENE DIAMINE

By RAMA SHANKAR RAI

Chemical Laboratories, Allahabad University

A solution of paraphenylene diamine, glycine and sodium sulphate in water acts as a developer in photography. It reacts with the silver of the latent image and produces ultrafine grains. Various mechanism have been suggested so far for the physical as well as chemical development. The present mechanism for the silver grain formation suggested here deals with the coagulation of silver bromide, which is stabilized by gelatine. Paraphenylene diamine forms a free radical in solution like butadiene and this free radical instantaneously changes to quinone, which reacts with positively charged silver ions in the gelatine. Glycine present in the solution behaves as a zwitter ion. Sodium sulphite controls the pH value of the solution, thus minimising the fog.

COAGULATION OF STANNIC OXIDE SOL

By RAMA SHANKAR RAI *and* SATYESHWAR GHOSH

Chemical Laboratories, University of Allahabad

Sols were prepared by peptizing freshly precipitated and well washed hydrous and stannic oxide by ammonia. It were dialysed to give sols of different purity, which was represented by SnO_2NH_4. To a fixed volume of the sol, barium chloride solution was added stepwise and the volume was made constant by addition of water. pH was measured. From the total conductivity of the mixture, the conductivity of the added electrolyte was subtracted. Sols were aged at room temperature for several months and exactly the same experiments were repeated.

A perusal of the data shows that the sol liberates acid. Aged sol liberates lesser amount of acid than the fresh one. The conductivity of the pure sol decreasd, while that of the impure sol increased by ageing. A gradual fall in the conductivity in the fresh as well as in the aged sol was observed by the addition of the electrolyte. These results have been explained by a new mechanism of coagulation.

KINETICS OF OXIDATION OF GLUCOSE AND FRUCTOSE BY ALKALINE BIVALENT COPPER IN PRESENCE OF CITRATE PART III

By MATHURA PRASAD SINGH *and* SATYESHWAR GHOSH,

Department of Chemistry, University of Allahabad

In this paper we have studied the reduction of alkaline bivalent copper in sodium citrate medium by dextrose and laevulose and the following significant facts have been observed

(1) The reaction is unimolecular with respect to the reducing sugar.

(2) It is zeromolecular with respect to copper citrate complex.

(3) The reaction has an induction period which is due to autocatalysis of cuprous oxide produced in the reaction.

(4) The reaction velocity is independent of the concentration of sodium citrate but the minimum amount sodium citrate required to form the complex is in the ratio 1 : 1 to copper sulphate. At higher concentration of alkali the stability constant of this complex decreases and the amount of citrate required is greater than this ratio to keep copper in solution.

(5) The reaction velocity is enhanced by increasing the concentration of hydroxyl ions, but it is not directly proportional to hydroxyl ion concentration.

(6) The previous treatment of the sugar leads to enhancement of reaction velocity in the case of dextrose while it decreases in the case of laevulose.

(7) The laevulose is a stronger reducing agent than dextrose.

STUDIES IN INTERACTON OF FERRIC AND CHROMIUM CHLORIDES WITH SODIUM SILICATES

By K. L. YADAVA *and* S. GHOSH

Department of Chemistry, University of Allahabad

Electrometric and conductometric titrations have been done in the interaction of chloride of iron and chromium with sodium silicate of different composition with respect to soda and silica. pH curves obtained are bilogarithmic in nature, the inflexion occuring beyond the equivalent value of soda in the sodium silicate which is explained as due to the action of silicic acid generated in the metathesis which is capable of adsorbing alkali.

From conductivity curves it has been inferred that in the interaction of ferric chloride and sodium silcate, formation of both ferric hydrous oxide and ferric sili-

cate takes place together, the latter being favoured in the strong solutions. A double compound of iron with sodium silicate is also produced in metathesis the at later stages of addition of sodium silicate solution. In case of chromium it has been observed that two compounds are formed when sodium silicate of 1 : 3.2 soda silica ratio is used while only one compound is obtained when soda silica ratio is 1 : 4.266 in the sodium silicate solution.

STUDIES IN INTERACTION OF BARIUM AND STRONTIUM CHLORIDE WITH SODIUM SILICATES

By K. L. YADAVA *and* S. GHOSH

Department of Chemistry, University of Allahabad

Analysis of the precipitate obtained by addition of sodium silicate to the chlorides of barium and strontium indicates the formation of the silicates of these alkaline earth metals in strong solutions. In dilute solutions the proportion of silica associated with metals in the precipitate is high. This suggests that in dilute solutions silicic acid is mostly generated. The above conclusion has been supported by conductometric studies of the metathesis of these chlorides with sodium silicate solutions. pH curves do not give any salient information.

NOTE ON THE BEHAVIOUR OF CERTAIN INORGANIC METALLIC COMPOUNDS UNDER COSMIC RADIATION

By S. S. NEHRU

Allahabad

Certain basic assumptions, with a view to first approximations have to be made at the start, as follows :—

(1) Cosmic radiation is falling regularly and *vertically* from above.

(2) This is steadiest in the early *morning* and *evening* hours.

(3) Tests are made under cover, so that *local* radiation from clouds or surrounding matter is avoided.

(4) Such vertical radiation is falling on the broad *superficies* of the substance examined.

(5) Equal areas are irradiated in closed tubes, so as to ensure the same *geometry*.

(6) The effect of the primary radiation together with the consequental secondaries, cascades and showers is studied *laterally* from a side.

(7) Such derivative radiation is made to fall on the tube of a *Geiger* Counter placed parallel to the tube containing the matter under study.

(8) To ensure minimum *error* or *fatigue* in the Geiger, counts are taken of the number of discharges during 10 *seconds at a time*, followed by 45 second rest.

(9) *Background* discharge is noted before and after readings as, its *constancy*, is a first indication that the instrument is behaving *reliably*.

(10) For each metallic compound, at *first* the count is taken under *free* cosmic energy, and *thereafter* the count is taken when the compound is screened under a lead cover 1. cm. thick, with 15 cm. of metal plates piled on top, to ensure *complete* elimination of cosmic radiation and prevent its affecting the compound.

(11) The difference betwe enthe two readings gives, in *each case*, gives the pure and *corrected reaction* of the compound to cosmic radiation falling on it at the time concerned.

(12) This is plotted as a *graph* against the *atomic number* of the metal. This graph is a straight line showing that the higher the atomic number or the number of protons the greater the reaction to protons of the cosmic radiation.

(13) The exact interplay of the two types of protons, outside and metallic is under further study.

CHOICE OF INTERNAL STANDARD IN QUANTITATIVE SPECTRO-CHEMICAL ANALYSIS SO AS TO ELIMINATE THE EXTRANEOUS ELEMENT EFFECT

By J. K. ZOPE *and* J. D. RANADE

Department of Physics, University of Saugar

Intensity of a line of an element under test is affected by the presence of other elements present in the sample. Here we have shown by carrying on experiments in which the effect of the extraneous elements, calcium and potassium on the intensity of the manganese lines is studied in presence of iron as the internal standard. The intensity ratio of the analysis line to that of the test element remains constant, if a proper internal standard is chosen and the extraneous element effect is eliminated.

COAGULATION OF CONCENTRATED FERRIC HYDROXIDE SOL BY PHOSPHATES AND OTHER ELECTROLYTES

By A. C. GUPTA *and* N. R. DHAR

Sheila Dhar Institute of Soil Science, University of Allahabad

Concentrated sol of ferric hydroxide has been prepared by peptizing by acetic acid. Coagulation was studied with mono, di and tribasic phosphates of sodium, potassium and ammonium and coagulation powers were determined.

AN INVERSION FORMULA FOR THE THIRD ITERATE OF LAPLACE TRANSFORM

By B. B. MISRA

Department of Mathematics, D. S. B. Government Degree College, Naini Tal

THE THEORY AND MECHANISM OF SOLID-SOLID REACTIONS

By K. P. SINHA

National Chemical Laboratory of India, Poona

DIFFRACTION OF OBLIQUE SHOCK WAVE PAST A SMALL BEND

By R. S. SRIVASTAVA *and* RAM BALLABH

Department of Mathematics, University of Lucknow

STUDIES ON HYDROUS ZINC OXIDE
PART IV. HYDRATION OF ZINC OXIDE SAMPLES PRECIPITATED AT DIFFERENT TEMPERATURES

By KALI CHARAN VARSHNEY *and* ARUN K. DEY

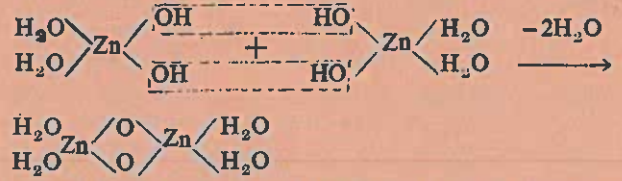
Departments of Chemistry, S. M. College, Chandausi and University of Allahabad

In a recent paper Shaw and Dey (Nat. Acad. Sci., India, Annual Number 1954) have advanced a hypothesis based on Inorganic Polymerisation to explain the variation in properties of hydrous oxides obtained under different conditions. In previous parts of the series we have studied the precipitation and properties of hydrous zinc oxide obtained under different conditions. In this paper we have described our results on the hydration of the precipitates obtained at different temperatures and also the effect of age on the precipitates and have explained the variation from the viewpoint of inorganic polymerisation It was found in general that the water associated diminished with the increase in the temperature of precipitation and also with growing age of the samples.

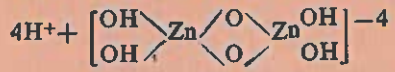
Zinc possesses a coordination number of four and on the addition of alkali to a zinc salt solution precipitation occurs according to the equation :

$$[Zn\ (H_2O)_4]^{2+} + 2OH^- = [Zn\ (H_2O)_2\ (OH)_2]^0 + 2H_2O$$

The precipitated hydroxide then polymerises according to the following scheme :



Due to the *amphoterism* the above compound liberates protons as :



and the anion is capable of further polymerisation giving rise to larger units with the liberation of H_2O. This phenomenon is more pronounced when the precipitation is carried out at higher temperatures.

ON WHITTAKER TRANSFORM

By DINESH CHANDRA

Department of Mathematics, University of Lucknow

LORENTZ-LORENTZ EXPRESSION AS A NEW ANALYTICAL CONSTANT

By A. C. CHATTERJEE

Department of Chemistry, University of Lucknow

OXIDATION OF n-BUTYRALDEHYDE BY CHROMIC OXIDE

By A. C. CHATTERJEE *and* V. ANTHONY

Department of Chemistry, University of Lucknow

ALUMINIMUM TRI-SOAPS

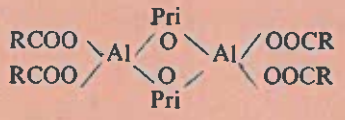
By R. C. MEHROTRA *and* K. C. PANDE

Department of Chemistry, University of Lucknow

The aluminium salts of higher fatty acids are important articles of commerce but their nature and composition are, however, suprisingly obscure. Over a period of

25 years a number of prominent workers including J. W. McBain and K. J. Mysels in America, A. E. Alexander and J. H. Shulman in England and Ostwald and Eigenberger on the Continent have repeatedly reported their failure to prepare the tri soaps of aluminium. In none of the above attempts the ratio of the fatty acid to aluminium could be achieved higher than 2 : 1. From the above they concluded that the tri soaps probably do not exist. It has been found that when one molecule of aluminium isopropoxide is treated with an excess of fatty acid in benzene, three molecules of isopropanol could be distilled out azeotropically. The product on the removal of the excess of the fatty acid by a suitable solvent in which the fatty acid is soluble and the soap was insoluble such as dioxan or acetone, were in all cases found to be tri soaps of aluminium. Tri-valerate, tri-laurate, tri-myristate, tri-palmitate and tri-stearate of aluminium have been prepared by this method.

The failure of the earlier workers to prepare these tri soaps of aluminium have been explained on the basis of the slowness of the final stage of the reaction caused by stearic hinderance as the di-soaps will probably have the bridge structure of the type.



The hydroxy di soaps of aluminium are well known to give gels in hydrocarbon solvents. Mc Roberts and Schulman in 1950 predited that tri-soaps, if prepared, would not show any tendncy of gelation. In conformity with their views the above tri-soap have been found to give quite mobile solution in benzene.

Even for the lowest member of the series Gray and Alexande in 1950 summarised the position as below. It is seen that aluminium acetate as regards its chemical composition and heat of formation, does not differ from the salts of the higher fatty acids. It is remarkable that, despite the widespread use of this substance in pharmacy and in the study of colloids, little attempt has been made to investigate its composition. Hood and Ihde soon after have reported the preparation of aluminium acetate and propionate by the reaction between aluminium chloride and a mixture of corresponding acid and its anhydride under anhydrous conditions.

Aluminium tri derivaties of the lower fatty acids viz., acetic, propionic and butyric have been prepared by us, by the reaction between Aluminium iso propoxide or ethoxide and the corresponding acid anhydride.

$$Al(OR)_3 + 3\begin{matrix} R'-CO \\ R'-CO \end{matrix}> O \rightarrow Al(OOCR')_3 + 3RCOOR'$$

It has been shown that the reaction upto the formation of monoalkoxy di acid compound is highly exothermic and is completed within a short period of time.

$$Al(OR)_3 + 2(R'CO)_2O \rightarrow Al(OR)(OOCR') + 2R'COOR$$

However, the third stage of the reaction is comparatively slower and the tri salts can be prepared only after a long refluxing. Aluminium triacetate and tripropionate were found to be white powder insoluble in benzene, whereas tri-butyrate was found to resemble the higher tri-soaps in being soluble to give a mobile solution in an inert solvent like benzene and n-hexane.

BIOLOGICAL SCIENCES SECTION

ABSTRACTS OF PAPERS

METABOLIC DISTURBANCE IN THE LEAVES OF LUFFA SP. FOLLOWING "YELLOW MOSAIC" INFECTION

By SHRI RANJAN AND GOVINDJEE

Department of Botany, University of Allahabad

(1) The work deals with the study of water soluble and alcohol soluble amino acids and amides and those obtained by hydrolysing the protein content of the healthy and diseased leaves of Luffa sp. It also includes study of water slouble free sugars and alcohol soluble organic acids of both healthy and diseased leaves.

(2) Amino acid analysis made on circular papers which were divided into 16 sectors by perforating radial fins at equal distances revealed the presence of following free acids:—leucines, phenlyalanine, valine+mesthionine, aminobutyric acid, alanine, glutamic acid, aspartic acid+glycine and asparagine in healthy leaves. The acid hydrolysate however contained leucines and phenlylalanine, valine and methoinine, tyrosine, alanine, glutamic acid and threonine, aspartic acid and glycine, arginine and histidine+lysine both in the healthy and diseased leaves. Sugar analysis revealed gluose+galactose and fructose and, organic acid analysis citric acid, malic acid and ketosuccinic acid.

(3) The diseased leaves showed marked decrease in aspartic acid content, slight decrease in citric and malic acid, absence of asparagine and increase in sugar content specially glucose and galactose.

(4) The authors have tried to put the possible fates of decreased soluble protein contents. It is suggested that tracer studies be carried out on the synthesis of virus itself to elucidate and explain the results obtained.

QUANTITATIVE STUDIES ON FRESHWATER PLANKTON I. PLANKTON OF A FISH-TANK IN LUCKNOW, INDIA

By S. M. DAS *and* V. K. SRIVASTAVA

Department of Zoology, University of Lucknow

The present study is based on regular weekly hauls of plankton by a standard Nausen net. The individual components of the plankton show marked fluctuations

in their percentage composition during the year. There is a definite inverse correlation between the amount of zooplankton and phytoplankton during the year, i.e. the zooplankton is inversely proportional to phytoplankton in amount.

The entire year can be divided into various dominant periods, dominated by a particular group of organisms. July and August can be designated as the *Volvox period* ; September, October and November as the *Copepod period* ; December and January as the *Cladoceran period* ; February and March *Myxphyceae period* ; and April, May and June as the *Ostracod period.* We have also demonstrated, to our knowledge for the first time in India, the presence of 2 definite plankton peaks, one in the monsoon and the other in the spring season. These two peaks are mainly due to variations in the saltcontent of the waters.

NITROGEN REQUIREMENTS OF GLOESPORIUM MUSARUM G. PAPAYAE AND COLLECTOTRICHUM PAPAYAE.

By R. N. TANDON *and* JAWAND SINGH GREWAL

Department of Botany, University of Allahabad

The organisms were grown on 27 different sources of nitrogen. Care was taken to supply the same amount of nitrogen from every source. The growth and reproduction was recorded at regular intervals. The results were statistically analysed and the best source for each organism was determined.

QUANTITATIVE STUDIES ON FRESH-WATER PLANKTON II. CORRELATION BETWEEN PLANKTON AND HYDROLOGICAL FACTORS

By S. M. DAS *and* V. K. SRIVSTAVA

Department of Zoology, University of Lucknow

Das and Srivastava (1955) and Alikunhi (1955) have given some data regarding plankton in fresh water fish tanks recently, but little quantitative plankton data are available from Indian freshwater. Along with the standard weekly hauls, the hydrological factors were also studied every week, the factors being: temperature, pH, carbon-dioxide, oxygen, phosphates and silicates. It has been observed that phosphates and silicates increased during rains in July and August and reached the highest peak of the year. This coincides with the first or monsoon phytoplankton peak. Both the salts decreased rapidly after the plankton peak and showed low values in October, after which there was a gradual rise upto the month of January. During February there occurred the second or spring phytoplankton peak and both the salts showed low values

in February and March. This second phytoplankton peak, like the first peak, appears to be the direct result of increase in phosphates and silicates.

The oxygen and carbon-dioxide values show only minor variations throughout the year, except the two phytoplankton peaks when oxygen is supersaturated (daytime) and CO_2 shows depletion. Thus the values of CO_2 and O_2 are inversely proportional to each other during the year. The temperature (as also the intensity of sunlight), unlike what obtains in Europe, does not appear to be a controlling factor for Indian plankton peaks. However, although the temperature was lowest at the time of the second plankton peak, the highest temperature (May and June), definitely affected the plankton (both zoo and phyto). As plankton values were lowest during May and June. The pH is maximum during the phytoplankton peaks and minimum during the peaks of zooplankton, a fact demonstrated for the first time in Indian fresh-waters.

QUANTITATIVE ESTIMATION OF DEOXYRIBOSENUCLEIC ACID IN MALE GERN-CELLS OF CERTAIN INSECTS AT THE VARIOUS STAGES OF MEIOSIS

By M. D. L. SRIVASTAVA

Department of Zoology, University of Allahabad

In this work relative quantities of DNA at various stages of meiosis in Dissosteira carolina and Macropygium reticulare have been estimated by means of the micro spectrophotographic apparatus of Polliser. It has been found that there is no synthesis of DNA throughout the course of meiosis. The pre-prophase chromosomes already possess the maximal amount of DNA found in them during the later stages of meiosis. There is a slight synthesis of DNA at prophase also. During interkinesis, which is very short in duration, or sometimes may even be abolished, there is no synthesis of DNA. In consequence of this, the spermatids contain 1/4 the quantity of DNA found in the spermatocytes.

HOST-PARASITE RELATIONSHIP AND THE LARVAL ANATOMY OF APHYTIS DISAPIDIS

By S. MASHOOD ALAM

Department of Zoology, Aligarh Muslim University

Aphytis diaspidis How is an ectoparasite of *Chionaspis salicis* Linn in the field in U. K. The host is attacked in 2nd nymphal stage but not paralised. The unparasitized host hibernates as adult ; while the parasite undergoes winter-sleep in the larval

stage. The parasite and the host have one generation per year each. The parasite is considered as a successful one for the control of *C. salicis*. The larva is broadly oval. The head with gnathal appendages is distinct from the trunk. The shape of the larva hinders easy differentiation of the dorsal and the ventral surfaces. The digestive, excretory, nervous and respiratory systems are described with possible branchings of the last one.

ON THE YOLK-NUCLEUS OF BALBIANI IN THE OOCYTES OF SEMNOPITHECUS ENTELLUS

By H. B. TEWARI

Department of Zoology, University of Lucknow

During studies on the cytoplasmic inclusions in the oogenesis of *Semnopithecus entellus* (the common Himalayan Langoor) the author came across a clear picture of the yolk nucleus of Balbiani in the young oocytes. The oocytes show only one type of the yolk nucleus i.e. the rounded yolk nucleus of Balbiani. It appears as a well defined, clearly demarcated round structure which is of thicker consistency than the rest of the cytoplasm. It is devoid of any type of cytoplasmic inclusion-both active (Golgi bodies and Mitochondria) and inactive (fat spherules etc.). The colour contrast between the yolk nucleus of Balbiani and Mitochondria after Shridde fixative has clearly drawn the distinction between the two inclusions. Mere accumulations of Golgi bodies and Mitochondria in juxtanuclear position is not a sufficient argument to label them as yolk nuclei as has been advocated by some cytologists, both in India and abroad.

The 'yolk nucleus substance,' demonstrated by Beams and Sheehan (1941) in yolk nucleus complex of human ova, should be the only component to which the term yolk nucleus may be applied. There is no doubt that various cytoplasmic inclusions may be attracted to the yolk nucleus area due to more functional activity in the area. Thus they may be in association with the yolk nucleus ; but certainly the term yolk nucleus cannot be collectively applied to yolk nucleus substance and other cytoplasmic inclusions lying in association with the yolk nucleus proper.

MORPHOLOGY AND LIFE HISTORY OF CLINOSTOMUM MICROSTOMUM ; N. SP. (TREMATODA ; CLINOSTOMATIDAE) PART I. AVIAN PHASE OF THE LIFE CYCLE WITH AN ACCOUNT OF THE METACERCARIA AND THE ADULT

By R. N. SINGH

Department of Zoology, Mahakoshal Mahavidyalaya, Jabalpur

It has been established experimentally that nonencysted matacercariae from the body cavity of the fish *Nandus marmoratus* would develop to sexual maturity in the

buccal cavity of several species of herons, *Egretta garzetta* (Linn.), *Bulbulcus ibis* (Linn.) and *Ardeola grayii* (Sykes). The metacercaria is a juvenile fluke measuring 4.08 mm. to 5.36 mm. in length and 1.2 mm. to 1.6 mm. in breadth, with oral and ventral suckers, spines all over body, a reserve excretory system in the form of a network in addition to the primary one as found in Strigeid metacercariae and has the general structural features of the adult fluke. The reproductive system, however, remains rudimentary and its differentiation and other changes take place after the metacercaria has entered the definitive host. After administration in the final host, the metacercariae migrate in the buccal cavity of birds and lie below the tounge within 12 hours. During migration and attachment, the fluke continues to grow and mature. A period of three to six days is necessary for the maturation of these parasites.

The adult parasites obtained from natural as well as experimental infections differ from other described species of *Clinostomum* in several respects specially the body shape and small size, relative positions of the oral and ventral suckers, the extension of vitelline follicles, the location of the genital pore, the structure and position of the ovary and testes, and several other characters. The parasites measure 3.8 mm. 6.8 mm. (av. 6.44 mm) in length and 1.9 mm.-2.6 mm. (av. 2.28 mm.) in breadth. The parasites differ from other species of the genus *Clinostomum* already described by Osborn (1911-12), Rudolphi (1809), Braun (1906), Baer (1933), Yamaguti (1934) and Tubungui (1939) and others in a number of characters.

CYTOPLASMIC INCLUSIONS IN THE OOGENESIS OF SEMNOPITHECUS ENTELLUS (THE HIMALAYAN LANGOOR)

By H. B. TEWARI

Department of Zoology, University of Lucknow

Granular forms of the Golgi bodies and mitochordria have been observed. The distribution of these inclusions follow more or less a regular path starting from juxtanculare region to the cortical region in the developing Oocytes.

ON FASCIOLA INDICA VERMA, 1953, THE COMMON LIVER FLUKE OF INDIA

By R. S. TANDON

Department of Zoology, University of Lucknow

The common liver fluke was mistaken to be *Fasciola gigantica* Cobbold, 1855, only because of its large size and superficial knowledge of its morphology. Verma (1953) created a new species *Fasciola indica* for these forms, which he collected from the bile ducts of cattle, *Bos indicus* in Bihar, Assam, Rangoon and Malaya and *Bos bubalis*,

buffalo in Bihar and Assam and pig in Singapore. The various authors reporting these flukes from cattle and buffalo and also from the sheep and goats, and once from the lungs of a goat (Srivastava 1939), did not write anything about their characters.

No definite and detailed description has been given by any of the Indian workers prior to Verma (1953) and all of them assigned it to *Fasciola gigantica.* I also while describing the life history of the fluke in India (Thapar and Tandon 1952) took it to be *F. gigantica.*

I agree with Verma (1953) in creating a new species for the common liver fluke, parasitising the cattle and buffaloes in India.

The details of morphology described by me in my paper reveal certain interesting points not noted by Verma (1953) who also did not describe the details in his paper.

The pinkish colour of the fresh specimens (grey by Verma) (2) the uncertainty of the prominence of the shoulders (3) uniform distribution of palmate scales over the body (4) Ventral blind oral pouch opening into the oral sucker and resembling the oesophagus, not the intestine in its histology (post buccal ring leading into a blind pouch Verma, 1953), (5) testicular area less than half to half of the total body length (less than half, Verma) (6) muscular cirrus with curved, pointed and solid spines and a small terminal portion, through which the cirral duct opens to the outside, named as *cirrus glans* by me and the variable position of the ovary-either on the left or on the right and also medianly placed in some specimens, are the salient features noted in these forms, which probably missed Verma's (1953) attention, as he worked with a limited number of preserved specimens, which he took to Britain with him. The material at my disposal was inexhaustible and my conclusions were drawn after the study of several hundreds of specimens obtained on different occasions during the various parts of the year.

PATHOLOGICAL STUDIES OF A STORAGE ROT OF APPLES CAUSED BY ASPERGILLUS TERREUS

By R. N. TANDON *and* O. K. BHATNAGAR

Department of Botany, University of Allahabad

1. The symptoms of the disease have been described.
2. It was observed that the infection could take place through injury or through calys end or the stem end of the fruits.
3. The effect of temperature, light and humidity on the advance of rot was studied and the details have been recorded.
4. Cross inoculations showed that "Nakh" and "Nashpati" were also succeptible but guavas were not attacked.
5. "Kashmiri" variety of apple was more susceptible than "Kullu" variety.
6. Methods for the control of the rot have been suggested.

MORPHOLOGY AND LIFE HISTORY OF CLINOSTOMUM MICROSTOMUM N. SP. (TREMATODA; CLINOSTOMATIDAE). PART II. OBSERVATIONS ON THE EGG AND THE MIRACIDIUM

By R. N. SINGH
Department of Zoology, Mahakoshal Mahavidyalaya, Jabalpur

After determination that metacercariae from the fish *Nandus marmoratus* would develop to sexual maturity in several species of herons as described earlier in Part I of this series an attempt was made to study the eggs and the miracidium of this species of *Clinostomum*

The eggs of the parasite which could be obtained in the sputum of experimental birds as well as when the parasites are removed and placed in water are oval, operculate measuring 0.084-0.09 mm. (av. 0.088 mm.) in length and 0.048mm-0.054 mm (av. 0.05 mm) in breadth. The capsules when laid in water are in definite chains and in an uncleaved state, and require 5-7 days before the miracidium is ready to hatch. Temperature, pH value of water, and light are the chief factors which control the rate of embryonic development and hatching process. A pH of 7.0-7.5 and temperature of 25°-30°C is suitable for obtaining large number of miracidia.

The miracidia are very small, rod shaped white organisms measuring 0.13 mm-0.16 mm. (av. 0.14 mm) in length and 0.04 mm-0.06 mm (av. 0.06 mm) in breadth, are characteristic of the group. It possesses 21 ciliated epidermal plates arranged in four transverse tiers, a rectangular nerve mass an epical gland with stylet three eyes forming a composite mass in the centre of the brain, two pairs of flame cells, a germ in the posterior region, a pair of penetration glands, and a pair each of lateral process and lateral papillae.

It has been found experimentally that the miracidia attack and penetrate two species of snails *Lymnaea luteola* and L. *accuminata* and develop into mother and daughter rediae within 12 to 15 days. Further experiments which are in progress for the determinations of the development of the sporocyst and cercariae will give the entire picture of the intramolluscan phase of the life cycle and will be communicated in due course.

MORPHOLOGY AND POST-EMBRYONIC DEVELOPMENT OF THE MALE REPRODUCTIVE ORGANS OF LEUCINODES ORBONALIS GUEN (LEPIDOPTERA, PYRAUSTIDDE)

By U. S. SRIVASTAVA *and* B. P. SRIVASTAVA
Department of Zoology, University of Allahabad

In the adult, the testis is a large median mass giving out a pair of vasa deferentia which run behind to meet the paired ejaculatory ducts the anterior ends of which are

continued into a highly coiled tubular accessory gland each. Posteriorly, the paired ejaculatory ducts join to form the common ejaculatory duct entering the tublar aedeagus on each side of which is found a leafy valve. The genitalia are covered above by the broad tegumen bearing at its apex a spherical uncus. The vinculum is a narrow plate below.

In the early fourth instar larva, the testes appear as a pair of masses from the ventro-lateral margins of each of which the enveloping epithelium runs behind as a solid cord of cells. The primary genital invagination also appears on the ninth sternum and on its sides, partly projecting in it, arise a pair of ectodermal genital lobes. As the larva grows, the testes are further differentiated and gradually approximate, the solid cords develop a lumen and give rise to the mesodermal vasa deferentia. The primary invagination becomes deeper and wider and each genital lobe splits incompletely into an inner and an outer lobe. At the anterior end of the invagination, a pair of ampullae arise which become vesicular. Meanwhile, each testis is divided into two parts by an internal longitudinal septum. In the prepupa, these came closer but remain separate by their epithelial covering, the vasa deferentia are better differentiated and extend upto the posterior margin of the seventh segment. The vesicles arising from the primary invagination grow out into a pair of tubes whose anterior ends split longitudinally into two parts, the inner one forming the paired ejaculatory duct, the outer one the accessory glands. The two inner lobes meet each other to form the tubular aedeagus, enclosing the unpaired ejaculatory duct. In the pupa, the intervening well of the two testes disappear and form a compact mass. The vasa deferentia run upto the middle of the eighth segment and join with the growing paired ejaculatory ducts. The accessory glands elongate ; the adeagus becomes chitinous ; the outer lobes transform into valvae ; the ninth tergum, the ninth sternum and the tenth tergum transform into the tegumen, the vinculum and the uncus respectively and the last three segments telescope.

THE CONDITION FACTOR IN SOME FISHES OF LUCKNOW, U. P.

By S. K. MOITRA
Department of Zoology, University of Lucknow

The relation between length and weight in fishes remains relatively constant throughout life. The weight of fishes may be considered a function of the length. The relation of the length and the weight follows approximately the cube-law relationship expressed by the formula $K : W / L^3$, in which "W" is the symbol for weight and "L" the symbol for length. In so far as this is true, the weight varies as the cube of the length but this relationship is not absolutely constant since there are fat and slender

fish. This factor is commonly known as the Condition factor. Any increase of weight over length will raise the factor while the value will decline if the fish becomes thinner.

The Condition factor of four species of fishes viz., *Cirrhina reba* (Ham.), *Amblypharyngodon mola* (Ham.), *Oxygaster bacaila* (Ham.), and *Rohtee cotio* (Ham.), obtained from an experimental tank in the vicinity of Lucknow have been determined during the period 1-4-54 to 1-3-55. This factor has been found to vary from time to time during the same year and the extent of variation depends on the spawning and feeding conditions.

MORPHOLOGY AND POSTEMBRYONIC DEVELOPMENT OF THE FEMALE REPRODUCTIVE ORGANS OF LEUCINODES ORBONALIS GUEN (LEPIDOPTERA, PYRAUSTIDAE)

By U. S. SRIVASTAVA *and* B. P. SRIVASTAVA

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In the adult, each ovary has four ovarioles opening posteriorly into the paired oviduct. The two paired oviducts unite to form the common oviduct which runs behind and opens on the ninth sternum. A large saccular bursa copulatrix situated ventrally opens on the eighth sternum through the ostium bursae. The ductus bursae communicates with the posterior part of the common oviduct or vagina by the narrow ductus seminalis. The dorsal tubular spermatheca also opens into the vagina. A pair of long tubular accessory glands are situated posteriorly. Each opens into a reservoir communicating with the posterior part of the vagina through a short common duct.

The ovaries appear in the early larva as a pair of small patches. In the fourth instar larva, these are differentiated into four cylindrical masses which later form the ovarioles. Their epithelial covering extends behind upto the seventh segment as a solid cord of cells which would eventually give rise to the mesodermal part of the paired oviduct. Meanwhile, a pair of ectodermal swellings appear on each of the eighth and the ninth sterniters which soon develop into narrow grooves. A median invagination also appears on each of the two sternites, the one on the eighth sternite is wider and represents the uterine rudiment, the one on the ninth sternite is the spermathecal rudiment. In the prepupa, the ovarioles are further differentiated and the mesodermal lateral oviducts acquire distinct lumens. The paired grooves on the eighth and ninth sternites gradually disappear. The uterine rudiment grows forwards and its anterior end divides horizontally into a ventral bursal rudiment, while the dorsal part bifurcates into two ectodermal lateral oviducts. The spermathecal rudiment also grows forwards. Its median part fuses with the uterine rudiment, while the anterior free end would develop into the spermatheca. A dorsal outgrowth from the posterior part of the spermathecal rudiment soon bifurcaees to give rise to the accessory glands. Meanwhile, the intervening wall between the openings of the two rudiments become considerably depressed. In the pupa, the mesodermal and the ectodermal lateral oviducts join. The posterior wall of the uterine opening grows forwards leaving a narrow connection between the bursa and the common oviduct which would finally grow into the ductus seminalis, the original uterine opening now becoming the ostium bursae and the oviduct proper communicating to the exterior through the spermathecal rudiment on the ninth sternum.

A STUDY ON THE COMPARATIVE ANATOMY OF THE ALIMENTARY TRACT IN SOME FISHES OF UTTAR PRADESH, AND THEIR MODIFICATIONS IN RELATION TO THE FEEDING HABITS

By S. M. DAS *and* S. K. MOITRA

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The anatomy of the alimentary tract and the bucco-pharyngial region of fishes undergoes considerable changes, depending on the nature and food habits of the fishes. The present studies are confined only to six species of fishes obtained locally.

Labeo rohita (Ham.) and *Labeo gonius* (Ham.), are herbivorous fishes and feed mainly on aquatic vegetation and have no stomach. Teeth are absent in the bucco-pharyngial region. The gill rakers are simple, and cushioned pads are present on the roof of the mouth.

Eutropiichthyes vacha (Ham.), is an omnivorous feeder. The alimentary canal is comparatively shorter. A well defined stomach is present. Teeth on the roof of the buccal cavity consists of maxillary, vomerine and pharyngial. On the floor of the buccal cavity mandibular and horny pad teeth are present. The gill rakers are modified into tooth-like elongated processes.

Notopterus chitala (Ham.), *Ophicephalus striatus* Bloch., and *Bagarius bagarius* (Ham.), are carnivorous fishes. The alimentary system is short and complex with a stmoach. All the five types of teeth mentioned earlier are present, and the gill rakers are modified variously.

It appears therefore that the alimentary system is the simplest in the herbivorous fishes and the ratio between the total length of the fish and the total gut length (Das and Moitra, 1955) is high. In the omnivorous fishes the alimentary system gets modified and the ratio between the length of fish and that of the gut declines. In the carnivorous fishes the alimentary system is complex and the ratio between length of fish and that of gut is very low.

EFFECTS OF MOON ON THE DEVELOPMENT OF PLANTS I—UPTAKE OF CO_2 AND STOMATAL REGULATION IN ONION PLANTS DURING MOONLIT NIGHTS

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In my previous note I have shown that atleast in one way moon influences the development of reproductive organs of plants much in the same way as photoperiodic stimulus. It was noted that the long day plant of Onion when sown with rising moon tends to flower early ; whereas when grown with waning moon, flowering is delayed. Thus lunar illumination appears to be sufficient to induce floral anticipation. In order to confirm this idea, further experiments have been under-taken on CO_2 uptake by the plants and the stomatal regulations during moonlit nights, as a function of photoperiodism.

Hourly uptake of CO_2 by the onion plant sown with new moon was studied on full moonlit night. The following conclusions have been drawn from the observations :

(a) that the moon light appears to be sufficient to bring about the opening of the stomata. The degree of opening depends upon the intensity of moon light ;

(b) that there is a clear uptake of CO_2 during the moonlit nights. The intensity of uptake appears to depend upon the stomatial regulations; and that the moon light intensity appears sufficient to avoid compensation point.

MORPHOLOGY OF THE REPRODUCTIVE SYSTEM IN COLEOPTERA PART-I. MALE REPRODUCTIVE SYSTEM OF CYLRSTER TRIPUNCTALUS OLIVER (DYTISCIDAE)

By T. B. SINHA

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The male reproductive system consists of a pair of testes, situated on the 1st-2nd visible abdominal sterna ; a pair of epidydynis, located in the 3rd and 4th visible abdominal sterna ; a pair of vasa efferentia and vasa deferentia in the 2nd-4th visible abdominal sterna ; a pair of accessory gland, swollen at their apex and situated on the 1st-3rd visible abdominal sterna and the paired ejaculatory duct located in the 2nd visible abdominal sternum, meet in the 3rd visible sternum and form the common ejaculatory duct, which runs posteriorly to open into the chitinous frame work, the aedeagus.

The aedeagus consists of a median lobe, a pair of lateral lobes and a y-shaped structure, the spiculum gastrale. All these structures are covered from the ventral side by the last visible abdominal sternum which has got an aperture through which these organs are extruded for the purposes of copulation.

TWO NEW FISH TREMATODES OF THE FAMILY HETERPHYIDAE ODHNER, 1914

By P. N. CHATTERJI

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The author (1953) has described two new species of the genus *Haplorchis* Looss, 1899 one from the bird host-kite *Buteo rufinus rufinus* and another from a mammalian host dog *Canis domesticus* and has given comparative tables showing the characters of all the *Haplorchis* species known from bird and mammalian hosts respectively. The account of a new species of this genus from a fish host *Wallago attu* has been given in in this paper with a comparative table showing the characters of all the species known from fish host.

The genus *Polyorchitrema* Srivastava, 1938 was so far represented by his type species *P. piscicola* only. Here in this paper I have given an account of a new species of the genus and have given a comparative table showing the characters of both the species.

STUDIES ON THE MORPHOLOGY AND LIFE HISTORY OF CLINOSTOMUM GIGANTICUM, N. SP. (TREMATODA : CLINOSTOMATIDAE). PART I. OBSERVATIONS ON METACERCARIAE AND THE ADULT

By S. M. AGARWAL

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Nonencysted metacercariae obtained from an examination of *Ophiocephalus punctatus* fishes collected from a local tank were found attached in the branchial region, and in heavy infections were observed to be coming out of the body cavity through the opercular aperture. As a result of feeding experiments, the metacercariae were found to attain sexual maturity in *Ardeola grayii* (Sykes) and *Bulbulcus ibis* (Linn.) within a period of six days. The study of the adult both from the whole mounts and sections showed many features of special interest e.g. body size 9.75-14.1 mm (av. 11.58 mm.) in length and 3.15-4.5 mm. (av. 3.97 mm.) in breadth ; distance between the suckers 1.05-1.80 mm. (av. 1.33 mm) ; extension of vitellaria from a little beneath the ventral sucker upto the posterior tip of the intestinal caeca ; the vitelline cells not meeting in the middle line, either anterior to the uterus, or in the region of it ; the testes in the posterior two fifths of the body, the anterior testis almost undivided into lobes, the pos-

terior three lobed ; distinct pars prostatica (c.f. Yamaguti, 1933-34) ; nontuberculated coiled cirrus with cuticular striations on its surface and the genital pore to the right of the anterior testis a little away from it and at about the level of its centre.

Such important characters of the adult, as the very large body size, extension of vitellaria, larger distance between suckers, nature and position of testes, parsprostatica, non-tuberculated cirrus and its cuticular striations and the position of the genital pore ; and of the metacercariae, as the host specificity, non-encysted condition and their large size mark the present form as a new species.

STUDIES ON THE MORPHOLOGY AND LIFE HISTORY OF CLINOSTOMUM GIGANTICUM. SP. (THREMATODA : CLINOSTOMATIDAE) PART II. OBSERVATIONS ON THE EGG AND THE MIRACIDIUM

By S. M. AGARWAL

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The present paper dealing with the study of the egg and the miracidium forms the second part of the study on the morphology and life history of *Clinostomum gigantica*, the adult and metacercariae which have been described earlier in part I.

The parasites lay their eggs in characteristic strings when taken out and kept in water. The eggs are elliptical, operculate and measure 0.09×0.057 mm. They hatch out on the eighth and ninth days (cf. Hunter, 1934) at a pH of 7.0-7.5 and temperature of 25-30 C. The miracidia are rod shaped structures measuring 0.1-0.14 mm. (av. 0.12 mm) in length and 0.03-0.06 mm. (av. 0.04 mm) in breadth. The miracidia are characterized by the presence of 21 ciliated epidermal plates arranged in four transverse tiers ; two pairs of flame cells ; a pair of penetration glands ; a pair each of lateral papillae and lateral process (cf. Hunter, 1934) ; nerve mass in the centre of which three eye spots forming a composite mass ; a sac like gut and a sharply demarcated germ ball in the posterior region.

For the intermolluscan phase of the life cycle *Indoplanorbis exustus*, *Lymnaea luteola* and *L. accuminata* were tried as molluscan host separately. A series of infection experiments revealed that the miracidia failed to develop in the former whereas they developed in the latter two species of snails. The mother rediae and the daughter rediae could be obtained from these experiments on the sixth to eighteenth day after infection beyond which period the snails did not survive.

The observations on the structure of the sporocyst, mother and daughter rediae and cercariae will be communicated in another paper when completed.

REGENERATION OF THE LENS IN THE EYE OF RANA TIGRINA

By M. D. L. SRIVASTAVA *and* A. N. BHATNAGAR

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The iris of the eye in Rana tigrina lacks the potency to regenerate a new lens in the event of surgical removal of the eye lens proper. In all cases of complete removal of the lens, the eye lacks a lens. Our work does not support the conclusions of Pasquini and Della Monica (1929, 1930), Wacks (1920) and some others, but is in consonance with the findings of Stone and Sapir (1940).

In most cases the surgiçal removal of the eye lens in Rana tigrina is incomplete, a fragment of the lens, consisting of the lens capsule and a row of epitchelial cells of the lens, is left in the eye. This gradually grows and gives rise to a new lense, or to a chain of lenses, out of which a single one grows to more or less normal size, the rest remaining markedly small.

Some of these regenerated lenses show vaculoation in the interior, but about 50 per cent of the lenses are quite normal. Our findings do not corroborate Okada's statement that all the regenerated lenses are vacuolated.

Attempts at inducing Wolffa in regeneration of eye lens by the method of Sato, by implanting small pieces of iris, free of connective tissue, into operated eyes, have not yielded postitive results in this material.

Further experiments are still in progress.

ON THE EFFERENT BRANCHIAL SYSTEM OF MASTACEMBELUS ARMATUS RITA RITA AND ANABAS TESTUDINEUS (TELEOSTOMI)

By DEVENDRA B. SAXENA

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The elaboration of the efferent branchial system of Teleostomi has received very little attention in the past except by Ridewood (1899) on the relations of the efferent blood vessels to the circulus cephalicus. The present contribution, to my knowledge is the first report of the structural modifications in the efferent branchial system of *Mastacembelus*, *Rita* and *Anabas*.

In *Mastacembelus* only the first and second efferent arteries join the circulus cephalicus, and by joining these arteries form the first supra-branchial. The third and fourth efferent arteries join to form the second supra-branchial which in turn joins the dorsal aorta. The coeliaco-mesentric artery is given out from the second supra-branchial of the left side.

In *Rita* also the first and second efferent arteries join the circulus cephalicus, and by joining these arteries form the supra-branchial which is a part of the circulus. The third and fourth efferent arteries join directly with the dorsal aorta where the latter receives the supra-branchial from both the sides. The coeliaco-mesentric is given out from the dorsal aorta separately.

In *Anabas* the efferent branchial system is much elaborated to collect the aerated blood from the accessory respiratory organs. The third and fourth join to form the supra-branchial The first supra-branchial of the left side joins the second supra-branchial of its own side, the latter also giving out the coeliaco-mesentric. The first supra-branchial of the right side join the dorsal aorta at the junction with the two second supra-branchial arteries.

SOME OBSERVATIONS ON THE ALIMENTARY CANAL AND THE ASSOCIATED GLANDS OF VAGINULA MACULATUS—A PULMONATE GASTROPOD

By DHARAM NARAIN

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The alimentary canal begins as usual with a slit like ventral mouth not bounded by any distinct lips. The mouth leads into a short buccal cavity, followed by the thick walled prominent pharynx with a well developed radula. The pharynx is supported laterally by a pair of spoon shaped cartilages and is worked by a complex system of protractor and retractor muscles. Into the postero-lateral margins of the pharynx open the main ducts of a pair of diffuse salivary glands. From the postero-lateral end of the pharynx starts the narrow oesophagus. This is followed by the long distensible crop opening posteriorly into the left antero-lateral margin of the stomach an elongated thick walled sack like structure. The wall of the stomach is much thicker on the posterior side than elsewhere. From the anterior side of the stomach on its right border starts the intestine. It extends forwards almost upto the pharynx and then bending back runs upto the hinder end of the body where it leads into a short ill defined rectum which opens to the outside at the posterior extremity of the body between the mantle and the foot, by a narrow anus.

The digestive gland, the so called liver, is a very voluminous racemose gland surrounding the intestine and the stomach and forming the major part of the visceral mass. It opens by only two main ducts into the stomach-one towards its anterior margin between the openings of the crop and the intestine and the other on the hinder margin.

The unique points observed are as follows :—

1. In the majority of pulmonata at the junction of the buccal cavity and the pharynx either one or two chitinous jaws are present. No jaw have been seen in Vaginulus.
2. Eales, describing the salivary glands of Aplysia, says that in all ehthyneura the salivary glands lie behind the nerve ring and the salivary ducts travel forwards through the ring to open into the pharynx. In Vaginula the salivary glands are distinctly anterior to the ring and so the question of the salivary ducts travelling forwards through the ring does not arise.
3. In Buccinum, Helix and some other molluscs three types of cells have been described in the epithelium of the alimentary canal viz ordinary columnar cells, gland cells and lime cells. In Vaginula only the two former types have been observed, but no lime cells have been found.
4. The stomach of Vaginula has very prominent septa projecting inwards from the wall into the cavity. The epithelial cells lining these septa are ciliated. They appear to provide extra space for the diffusion of digestive fluids and for the absorption of food juices.

A PRELIMINARY NOTE ON THE BOTTOM-FAUNA OF FISH-TANKS IN U. P.

By V. K. SRIVASTAVA

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In the course of observations on the bottom fauna there was noticed a marked variation in the distribution as well as in the percentage composition of the fauna, which is quantitatively rich and qualitatively diversified. Collections were made regularly with the help of a scoop-type bottom sampler, while the quantitative sampling was done with a modified Lea-Gibbon's sampler.

A very rich collection was made of the bottom-dwellers in the months of July, August and September, due to the excessive reproduction of snails and oligochaetes (*Dero*, *Nais*, *Chaetogaster*, and *Aeolosoma*). The samples of the subsequent months registered a gradual fall, till in December and January *Chironomus* larvae and dragon-fly nymphs increased the total catch somewhat. In the months of February and March snails (*Planorbis*) again dominated the samples. The oligochaetes registered an increase and reached a second maximum during the months of May and June. Apart from these major representatives, leeches, bivalves, aquatic insects, bryozoa, ostracods and dead cladocera, shrimps, fish fingerlings and snails were also represented with minor peaks. Besides these organisms, decaying as well as green aquatic weeds, green algae and diatom frustules were also represented in the bottom samples. Work in this line is in progress.

THE HYDROGEN ION CONCENTRATION IN THE ALIMENTRY CANAL OF ADULT ORTHOPTERA

By U. S. SRIVASTAVA *and* P. D. SRIVASTAVA
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The hydrogen ion concentration of different parts of the alimentry canal of sixteen species of Orthoptera has been determined. The pH of the gut ranges from 5.4 to 6.8. The pH of the midgut is higher than those of the foregut and hindgut and varies only slightly in different species, whereas the pH of the latter two is approximately at the same level thus showing that (i) the kind of food does not affect pH of the midgut and (ii) an efficient buffer system exists in the midgut.

The pH of blood is more or less the same as that of the midgut in all the cases examined.

ON THE AFFERENT BRANCHIAL SYSTEM OF MASTACEMBELUS ARMATUS RITA RITA AND ANABAS TESTUDINEUS (TELEOSTOMI)

By DEVENDRA B. SAXENA
Department of Zoology, University of Lucknow

The afferent branchial arteries and their origin in some fresh-water fishes have been recently worked out by Das and Saxena 1954, and Saxena 1955. To my knowledge no account of the circulation of blood in the respiratory region of *Rita* and *Anabas* exists, except in a general account of the internal anatomy of Opisthomi a short description of the circulation of *Mastacembelus* by Mitra and Ghosh 1931. The author has made new observations on certain peculiarities in the afferent arteries and origin in these fishes.

In Mastacembelus, a casual air-breather, the ventral aorta gives out from its expanded portion the third and fourth pairs of afferent arteries. Internally all these four arteries have separate origins, though externally they appear to originate from the same point. The second pair of arteries arise from the lateral wall of the ventral aorta by separate openings, away from the external common root of the other afferent arteries.

In *Rita*, which can survive out of water for a short time only, the third and fourth pairs of afferent arteries arise from a common opening in the roof of the ventral aorta. The second pair of arteries also originate from a single aperture.

In *Anabas*, with well developed accessory respiratory organs, the third pair of afferent arteries originate from separate openings in the lateral wall of the ventral

aorta. These then further give rise to the fourth pair of afferent arteries by giving off a vessel on its dorsal aspect. The second pair of afferent arteries originate from a common opening in the dorsal wall of the ventral aorta.

ON THE BEHAVIOUR OF SEX CHROMOSOMES IN TWO SPECIES OF INDIAN HETEROPTERA

By CHANDI CHARAN DAS
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The chromosome complement of *Dysdercus cingulatus* (Pyrrhocoridae, Heteroptera) is 16, and the species has an XY : XX mode of sex determination. The sex chromosomes (X and Y) are the smallest in the complement and they are clearly made out at the late diplotne and later stages of meiosis by their univalent nature ; the sex chromosomes assume a bipartite condition at the metaphase of the first meiotie division and this is retained to the end of meiosis. The X-and Y-chromosome do not pair, divide incompletely and segregate to the opposite poles of the spindle at the anaphase of the first meiotic division, and in the second meiotic division either the X or the Y, as the case may be, forms an accessory plate near one of the poles and passes without dividing completly to the pole of its side. At no stage of meiosis, it is possible to distinguish the X from the Y.

The chromosome complement of the males of *Sphaerodema annulatum* (Hydrometridae, Heteroptera-Hemiptera) is 29, and the mode of sex determination of the species is of XO : X X type. The X-chromosome is the smallest in the complement and is placed on the outer circle of the spindle at both the meiotic metaphases. It instead of dividing at the first meiotic division migrates entire to one of the poles and divides at the second meiotic division. The division of the X-chromosome at the second division precedes that of the autosomes.

The normal or 'unanomalous' behaviour of the X-chromosome at the first metaphase in *S. annulatum* may well be considered a case of reversion, while the complete failure of the X-and Y-chromosome to divide at both the meiotic divisions in *D. cingulatus* may as well be due to an abnormality in the time of division of the centromeres of the sex chromosomes leading to their complete inhibition during the cycle of meiosis.

MORPHOLOGY AND HISTOLOGY OF THE REPRODUCTIVE ORGANS OF GRYLLODES SIGILLATUS, GRYLLOTALPA AFRICANA, SCHIZODACTYLUS MONSTROSUS AND HIEROGLYPHUS I NIGROREPLETUS (ORTHOPTERA)

By P. D. SRIVASTAVA
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Male—The testes are strawberry shapped in *G. sigillatus*, kidney shaped in *G. africana*, rectangular in S. *monstrosus* and of intermediate type (according to the cla-

ssification of Laird 1943) in *H. nigrorepletus*. Histologically, the vasa deferentia in *G. sigillatus* and *G. africana* are similar but in the other two differ. The seminal vesicles in *G. sigillatus*, *G. africana* and *S. monstrosus* are formed by the convolutions of the vasa deferentia, but in *H. nigrorepletus* it is a separate structure. There are two sets of accessory glands in *G. sigillatus* and *S. monstrosus*, sut in *G. africana* an additional pair of these and also two bunches of prostate glands exist. In H. *nigrorepletus* there is a single pair of accessory glands. The ejaculatory duct is protusible in S. *monstrosus* and takes part directly in copulation. The couplatory apparatus consists of a median aedeagus and a pair of winglike parameres in *H. nigrorepletus*, is enclosed within a subgenital plate and has also endorparameres and rami in *G. africana* is represented by a single pair of small chitinous processes the dorsal median paramere loles are completely absent in *S. monstrosus*, it is completely absent.

Female—Each ovary in all the four forms consists of numerous closely packed panoistic ovarioles. The two lateral oviducts join to form the common oviduct which leads into the vagina through the bursa. The speramatehca in *G. sigillatus* and *G. africana* is saccular is composed of a compact rounded mass of coiled tubules in *S. monstrosus* and is a sinous tubular structure in *H. nigrorepletus*. In *H. nigrorepletus* it opens by a duct in between the ovipositor valves near the opening of the vagina, whereas in others into the bursa. The opening of the bursa into the va gina is guarded by flap like valves in *G. sigillatus*. The egglaying apparatus is highly compressed laterally and the second pair of valvulae are very short structures, lie close to each other in *G. sigillatus* and the second pair of valves are small slightly curved in *H. nigrorepletus*. In *G. africana* and *S. monstrosus* the egglaying apparatus is wanting.

STUDIES ON THE DIGESTIVE PHYSIOLOGY OF PRODENIA LITURA FAB.

By A. N. CHATTORAJ

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The larvae feed on a wide variety of leaves belonging to different families. The midgut secretes amylase, maltase, invertase, lactase, lipase and protease. The change of food plant does not affect the qualitative position of the enzymes secreted but it affects the pH of foregut as well as that of midgut which is contrary to the previous observations on other insects. The cause of the pH of midgut being affected by the change of food is under investigation with special reference to buffer system.

THE SPERMATOPHORE FORMATION AND THE PASSAGE OF THE SPERM IN LEUCINODES ORBONALIS GUEN (LEPIDOPTERA, PYRAUSTIDAE)

By U. S. SRIVASTAVA *and* B. P. SRIVASTAVA

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The morphology and histology of reproductive organs of *L. orbonalis* differs from

those of such Lepidoptera in which the spermatophore formation has been studied. Females copulate once or twice and one, or rarely two, spermatophores are found. It is an oval sac with a narrow neck. Three kinds of secretion are poured into the bursa by the male in succession. The secretion of the posterior third of the ejaculatory duct enters first ; that of the middle region enters next and forms the sac and neck of the spermatophore ; that of the anterior third enters, along with the secretion of the accessory glands towards the end and serves as nutrient.

The ductus bursae of the female is highly muscular and shows peristaltic movements by which the neck of the spermatophore breaks. The ductus seminalis is also muscular and sucks up the spermatic fluid by peristalsis. Downwardly directed spines at the entrance of the latter into the vestibule prevent the entry of cement detritus. The recepticulum seminis often exhibits violent movements which is considered to aid the suction of the spermatozoa. Fertilization occurs in the vestibule.

STUDIES ON THE FEEDING HABITS AND CERTAIN ASPECTS OF DIGESTIVE PHYSIOLOGY DACUS CUCURBITAE COQ.

By P. D. SRIVASTAVA

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The larvae feed on the fruit pulp. The adults rasp nectar from the flowers only, but cause a lot of damage by inserting their eggs in the fruit tissues. They prefer young cucurbit fruits but attack juicy fruits also. In the larva the gut is slightly acidic; more acidic in the adult. The pH of the gut is not affected by the fruit the larva feeds upon. The larval midgut secretes amylase, maltase, invertase, lactase, lipase and protease. The adult midgut secretes only invertase.

NOTES ON THE AIR BLADDER AND THE GAS GLAND OF MASTECEMBALUS ARMATUS

By RAJENDRA SINGH

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Boulinger (1904) distinguishes the class of fishes into two groups. (i) Physostomous type-those possessing a pneumatic duct, and (ii) Physoclistous-those devoid of it.

He describes the gas bladder of *Anguilla vulgaris* as an extreme modification of physostomous fishes possessing pneumatic duct-along with distinct rete mirabilia in contrast with physoclistous fishes possessing exclussively red glands instead of rete mirabilia.

This demarcation according to Goodrich does not hold good because exceptions are often found in both the groups.

With regards to the air bladder of Mastecembalus armatus nothing has been described. Berg (1940) has classified this family Mastecembalidae to be physoclistous but as for as my observations go, it has distinctly the pneumatic duct connecting air bladder and gut, as well as, folded type of gas glands which clearly supports the view of Goodrich.

It appears that the gas bladder obtained in *M. armatus* is transitional in form in which both the pneumatic duct and gas glands occur side by side.

The investgation of the gas bladder in this fish is being conducted to throw more light on the subject.

STUDIES ON THE ASSOCIATION BETWEEN NON-HOMOLCCOLS CHROMOSOMES DURING MEIOSIS IN FOUR SPECIES OF INDIAN DRAGONFLIES (ODONATA)

By CHANDI CHARAN DAS,

Department of Zoology, University of Allahabad

The spermatogonial complements of *Ceriagrion coromandelianum* (Coenagriidae-Zygoptera), *Urothemis signata signata* (Libellulidae-Anisoptera), *Tramea basilaris* (Libellulidae-Anisoptera) and *Abisogomphus bivittatus* (Gomphidae-Anisoptera) consist respectively of 27, 25, 25 and 23 chromosomes. A pair of very small chromosomes is present in the complement of each of the species, and the mode of sex determination in every case is of XO : XX type.

The X-chromosome is situated, as a rue, on the outer circle of the spindle at the first metaphase, and is eccentrically situated at the second mataphase. It divides equationally at the first and reductionally at the second meiotic division, always travelling earlier to one of the poles.

Non-homologous association between chromosomes by means of Feulgen-positive connecting threads is frequent in these species. The inter chromosomal connections presumably represent the drawn out portions of the matrix substance.

The autosomal bivalents of *C. coromandelianum* and *U. signata signata* carry deeply stained knobs at the pachytene. The high degree of hetropycnosis of the autosome segments in these too species is believed to result from precocious deposition of the cohesive matrix substance around the chromonemata.

THE CHROMOSOME CYTOLOGY OF POND SKATER GERRIS NEPALENSIS, DIST. (HETEROPTERA-HEMIPTERA)

By CHANDI CHARAN DAS

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The diploid complement of the male of *Gerris nepalensis* (Hydrometridae, Heteroptera-Hemiptera) is 23, i.e., a pair more than the characteristic for the genus and the species has a XO : XX type of sex determination. The largst element in the complement represents the X-chromosome, which is peripherally situated at both the meiotic metaphases. It divides equationally, but later to the separation of the partners of the autosomal bivalent, at the first meiotic division, and reductionally at the second meiotic division, travelling earlier to one of the poles.

The 23-chromosome number and the oriental distribution of *G. nepalensis* possibly indicate a more primitive condition of this species of pond skater. The chromosome set which is stated to be the commonest number of the genus, is presumably derived from the 23-chromosome set of *G. nepalensis* by two separate one-to-one chromosomal fusion involving a pair of autosomes of *G. nepalensis*.

PHYSIOLOGICAL STUDIES ON LINUM, USITATISSIUM

By S. RANJAN, A. P. MEHROTRA *and* S. N. GHOSH

Department of Botany, University of Allahabad

GEOLOGY AND PETROLOGY OF THE SAPRAR DAM AREA, MAURANIPUR, JHANSI DISTRICT, BUNDELKHAND

By M. N. SAXENA

Department of Gelogy, University of Lucknow

The rock types found in the area in the descending order are as follows :—

Tale schist.

Biotite muscovite schist.

Magnetite chlorite schist.

Quartzites.

Amphibolities and hornblendite.

Migmatites and composite gneisses.

Pink granites.

Quartz veins.

In the type area Bundelkhand, the presence of older rocks such as schists, quartzites and amphibolites etc. is noteworthy. The schistose rocks have been grantised to various type of composite genisses and the quartzites have been transformed to a pinkish granite.

FORMATION OF ASPARAGINE AND INCREASE IN THE FREE AMINO ACID CONTENT IN THE DISEASED LEAVES OF RICINUS COMMUNIS

By SHRI RANJAN *and* T. RAJA RAO

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A chormatographic study of the soluble and insoluble protein of healthy and diseased leaves of *Ricinus communis* has revealed a remarkable increase in the content of free amino acids and formation of free asparagine in the diseased leaves.

The following common free amino acids were identified tyrosine, α-amino butyric acid + β-alanine, alanine, glutamic acid, and aspartic acid. Three yellow bands having Rf values 0.90, 0.86, 0.80, which could not be identified, are found to be present in both the healthy and diseased leaves.

However, no change is observed in the amino acid composition of the acid hydrolysates of both the healthy and diseased leaves. The following amino acids were identified leucine+phenylalnine, valine+methionine, tyrosine, alanine, glutamic acid+threonine and histidine+lysine.

Such a formation of asparagine and increase in the other free amino acids in the 'mosaic' leaves suggests a metabolic disturbance caused by some virus infection.

'CARICA-MOSAI', VIRUS INFECTION ON THE SOLUBLE AND INSOLUBLE PROTEIN CONTENT OF CARICA PAPAYA LEAVES

By SHRI RANJAN, M. M. LALORAYA *and* RAJNI VERMA

Department of Botany, University of Allahabad

Chromotographic analysis of the free amino acids and those obtained by acid hydrolysis of healthy and 'mosaic' infected carica papaya leaves has shown the presence of two new ninhydrin reacting substances in the alcoholic extract of the mosaic infected leaves one corresponding to asparagine and the other to alanine. The other common free amino acids in the alcoholic fraction or aspartic acid and β-alanine amino+butyric acid.

The acid hydrolysate of the mosaic leaves show a decrease in the intensity of their bands in comparision to healthy leaves though without showing any qualitative change. The following amino acids have been identified : leucines+phenylalanine, valine+methionine, tyrosine, alanine, glutamic acid and threonine, glycine+aspartic acid, arginine and histidine+lysine.

It is suggested that the formation of asparagine and alanine may be either due to the breakdown of the insoluble leaf protein or through some other unknown metabolic process, induced by virus infection.

MORPHOLOGY OF THE REPRODUCTIVE SYSTEM IN COLOPTERA

PT. II REPRODUCTIVE SYSTEM OF CYBISTER TRIPUNCTATUS OL (FAMILY DYTISCIDAE)

By T. B. SINHA

Department of Zoology, University of Allahabad

The female reproductive organs consists of a pair of ovaries (Polytrophic) a pair of lateral oviducts which unite to form the common oviduct, an unpaired spermatheca, bursa, fertilization canal and vagina. The last one enters into a chitinous framework known as the external genitalia, which opens outside.

The histology of the various parts has been discussed in detail and in almost all parts excepting the spermathica it closely resembles an allied form *Dyticus marginals*. In spermatheca chitinised pillars, so characteristic of *Dytiscus marginalis*, are absent. The histology of the pear shaped gland has been described as well.

NOTES ON THE COXAL GLANDS OF PALAMNAEUS LONGIMANUS

By S. N. PRASAD

Department of Zoology, University of Allahabad

The coxal gland of the scorpion lies in segments V and VI with an outlet at the base of the posterior surface of appendage V. Each coxal gland consists of (i) a terminal sac or saccule, (ii) a short duct or collecting tubule leading into (iii) the labyrinth. Distally the labyrinth is often enlarged forming (iv) a bladder, a short duct from which leads to the external opening (v).

The saccule is lined by delicate epithelium composed of large cubical cells, appearing flattened in sections, measuring 2×1.5 D with prominent oval nuclei measuring 2×1 D. These cells have the property of excereting solid particles, which have been observed within them. This fact has been further confirmed by injecting carmine

which was picked by the cells only after a few hour. The nuclei of these cells have scattered chromosomes centrosomes. The protoplasm of the cells is granular and denser towards the base than towards the apex.

The labyrinth consists of a single coiled tube lined by excretory epithelium. The protoplasm of these cells is denser and striated at the base than at the apex, where it appears rather vacuolar. The cells measure 10×8D and are cubical. The nuclei of these cells are roughly rounded measuring 5× 5 D. Granular matter, probably secretion, has also been observed in the lumen. These granules are small of varying size and shape.

The duct connecting the saccule to the labyrinth is lined by fairly taller, rectangular cells measuring 0.3×1 D with oval nuclei.

The duct that leads to the outside from the labyrint is lined by flattened cells (2×1 D) with small oval nuclei measuring.

ON NEW LICHENS FROM THE HIMALAYAS-I

By D. D. AWASTHI

Out of a collection of over 2500 specimens of Indian Lichens in the author's herbarium, specimens of a few genera have so far been worked out and identified. During the course of the investigations several specimens new to science have been discovered by the author particularly from the Himalayan region. The present paper deals with such seven new species and one new variety. Out of these, two new species of the genus Cetraria (*C. pallida*, *C. nepalensis*) had already been reported by the author earlier (Awasthi 1954). The names proposed of the remaining five species included in the paper are *Physica melanotricha* Awasthi sp. nov., *Physica askotensis* Awasthi sp. nov., *Anaptychia himalayensis* Awasthi sp. nov. *Anaptychia pellucida* Awasthi sp. nov. and *Peccania Hoegii* Awasthi sp. nov. The new variety belongs to *Physica endococcina* as var. *latiloha* H. Magn. var nov.

Latinised diagnostic description and full English description and the distinguishing features from the related species have been fully discussed. An interesting behaviour in the production of deep blue colouration in the cortex of both the *Anaptychia* species after treatment with iodine solution has been observed. In addition *Peccania Hoegii* also exhibits peculiar dark nubilations in the thecium not observed so far in any lichen. The paper is intended to be one of the first of the series delaing with such new species from the Himalayan region.

A NOTE ON A NEW SPECIES OF PARMELIA FROM KODAIKANAL SOUTH INDIA

By D. D. AWASTHI

A collection of Lichens from Kodaikanal, South India, made in 1953 by Prof.

O. A. Hoeg, was sent to the author. In the collection were separated out 14 specimens of the genus Parmelia.

Out of these the author has identified 10 specimens so far, which belong to the following species : *Parmelia cirrhata, P. cetrata, P. dissecta, P. laevigata, P. Aronoldii, P. tinctorum* and a new species which though was found to be closely related to *Parmelia Bitteriana* but was distinct in many respects, and is therefore, named as *Parmelia pseudobitteriana* Awasthi sp. nov. The paper deals with the latinised diagnostic description and full English description.

ON THE STRUCTURE AND AFFINITIES OF SAHNIPUSHPAM GLANDULUM SP. NOV., FROM THE DECCAN INTERTRAPPEAN SERIES OF MADHYA PRADESH

By U. PRAKASH

Birbal Sahni Institute of Palaeobotany, Lucknow

In 1950, Shukla reported a small petrified flower, *Sahnipushpam*, from Mohgaon Kalan, the well-known locality of the Deccan Intertrappean Series in Madhya Pradesh but no detailed description of the flower has appeared so far. Recently the author collected large number of specimens of the late stages of flowers and their young fruits. from Mohgaonkalan and also from Bharatwada, which is another important fossil locality in Madhya Pradesh.

The flower of *Sahnipushpam glandulum* is 5 to 5.5 mm in length and 2.5 to 2.8 mm in diameter. It is sessile, bracteate, actinomorphic, hermaphrodite, cyclic and perigynous with a calyx-tuby possibly of receptacular in nature. The calyx is composed of 4-5 lobes and possesses secretary cavities. The presence of corolla in the flowers could not be detected. As regards the stamens, they seem to be inserted in the calyx-tube, but their exact number is not known. The anther is two lobed and dorsifixed. Its pollen grains are small, 2-colporate and syncolpate. The flower possesses 4.8-5.2 mm. long, pentacarpellary and syncarpous gynaecium with a superior, pentalocular ovary. There are usually two ovules in each of the four loculi and three ocules in the fifth loculus, but often there are only two ovules per loculus. Each loculus is further divided by a secondary partition. The ovary-well possesses marginal spherical sacs or glands of oil, tanin or resin. The style is united and the stigma is like a discoid plate. The young fruit of *Sahnipushpam glandulum* is a small ellipsoidal, woody capsule with a persistent calyx-tube. It exhibits septicidal dehiscence.

A comparison with the modern families reveals that the flower of *S. glandulum* shows close affinity with the family Myrtaceae of the dicotyledons.

VITAMIN C AND THE GOLGI BODIES

By H. S. CHAUDHRY,

Department of Zoology, D. S. B. Government College, Naini Tal

The cytochemical method of the demonstration of vitamin C in the animal cells was first pointed out by Gyorgi in 1927, who made use of the reducing property of this vitamin. Later, Giround Lablong (1934), and Bourne (1936) improved upon the technique and recommended the use of a solution of 10 gms of silver nitrate in 100 c.c of glacial acetic acid for this purpose. The high acidic pH of this fixative dissolve out the Golgi bodies and all other lipoids from the cells, only vitamin C gets impregnated with silver as black granules. Since vitamin C reduces silver, and these silver particles are found to lie in the same zones as the Golgi bodies in the preparations made by classical methods for their demonstration, led a number of workers to associate them with each other.

Duthies (1933), Deans and Morse (1948), Prasad (1953), and Barnett are inclined to view that the vitamin C is synthesised in the animals by the Golgi bodies in some direct or indirect way. Whereas, Tonutti (1937) and Hirsch (1939) are of the opinion that vitamin C is absorbed and concentrated into the Golgi apparatus. Barnett and Fishcher (1943) also state that the localization of silver granules in the region of the Golgi material shows some such association between them. But they have not given any reason why this should happen so.

As a result of the present investigation of the intraovarian oocytes of *Basbus* the author feels that there is absolutely no connection between vitamin C and the Golgi apparatus both in their localization and distribution. On the contrary the mitochondria appear to be associated with vitamin C, and possibily or, if at all, responsible in its synthesis. The chief reasons for such conclusion are (i) The Golgi apparatus is not visible under phase-contrast, while mitochondria are visible and take up Janus green B stain which are present exactly in the same position as vitamin C. in acetic-silver slides (ii) The Trypan glue, which is said to stain vitamin C, when injected in the body cavity of the fish is absorped to certain extent over the surface of mitochondread in intra-vitam studies. Bounne (1950) has also pointed out that vitamin C may be synthesised or in association with mitochonetria, pass to the Golgi vacuoles and these become aggregated into visible droplets.

Danielli (1953) has gone a step further and does not believe in the specificity of the silver nitrate technique for the localization of vitamin C. According to him the ascorbic acid molecules are of low molecular weight such as those of silver-nitrate and the initial reaction product of ascorbic acid and silver nitrate. They are all, therefore highly diffusible in the cytoplasm. "Thus as the silver nitrate-acetic mixture diffuses

into cells a mixing zone will be established some-where close to the cell wall in which ascorbic acid and silver nitrate will react." and further adds "Consequently if ascorbic acid exists in the cells as such it can only be demonstrated in the mixing zone." In fact the silver which is formed by reduction in this procedure is not found in the mixing zone but attached to mitochondria.

Baker (1953) in a series of papers has even doubted the specificity of the silver nitrate method for the demonstration of the Golgi apparatus and reduced the entire Golgi apparatus to the level of an artifact.

It is, therefore, clear that ascorbic acid cannot be said to be associated with the Golgi apparatus the very existence of which doubted in any way. If however, any association of vitamin C with other cellular inclusion be there it is with mitochondria.

PETRIFIED WOODS RESEMBLING THE MODERN GENERA TERMINALIA AND SONNERATIA FROM THE TERTIARY ROCKS OF SOUTH ARCOT DISTRICT, MADRAS

By C. G. K. RAMANUJAM

Birbal Sahni Institute of Palaeobotany, Lucknow

The material has been collected by me 3 1/2 years back from near Mortandra 5 miles W. N. W. of Pondicherry. The fossiliferous locality can be reached from Tindivanam on the Southern Railway. Mortandra is on the bus route from Tindivanam to Pondicherry.

The wood that shows a marked resemblance to the *Terminalia* species is a diffuse-porous one. The vessels are fairly large and mostly solitary. Tylosic in-growths are abundant. The perforations are simple and horizontal to steeply inclined. The intervessel pits are numerous, medium to large, alternate and distinctly vestured ; the pits are rounded or somewhat flattened. The vessel-ray pitting is more or less similar to the intervessel pitting ; the vessel-ray pits are 3-8 per cell, and distributed irregularly. The vessel-parenehyma pits are bordered and alternate.

The fibres are libriform and aseptate. Pits to the fibres are few, simple and circular.

The xylem parenchyma is abundant and is of two types (1) paratracheal, (2) diffuse. The paratracheal parenchyma is represented by considerably thick vasicentric to aliform, often locally confluent sheaths. The diffuse type consists of numerous solitary cells or small groups of cells scattered irregularly among the fibres.

The xylem rays are mostly uniseriate, and sometimes biseriate. They are 2-25 cells high and are weakly heterogeneous with 1-2 marginal rows of vertical cells. The ray cells are crystalliferous, there being a single crystal per cell.

Comparisons were made with various species of *Terminalia*, viz. *T. tomentosa*, *T. chebula*, *T. myriocarpa*, *T. catappa*, *T. belarica*, *T. paniculata*, *T. oblongata* etc.

The wood showing its greatest similarities to the species of *Sonneratia* is also diffuse-porous. It does not exhibit seasonal growth. The vesses are small and commonly in radial multiples of 2-3, although solitary vessels are not uncommon. The perforations are simple and oblique. The vessel-segments are medium, truncate or abruptly or alternately tailed on one or both sides. The intervessel pits are large, alternate, hexagonal and vestured. The vessel-ray pits are very small, rounded simple or bordred.

The fibres are libriform and septate. The interfibre pits are simple and aligned in a linear manner.

The xylem parenchyma is conspicuous by its absence.

The xylem rays are very fine, evenly distributed and mostly uniseriate; the biseriate condition is only sporadic. The rays are 3-12 cells high, and homogeneous with short procumbent cells.

Comparisons were made with *Sonneratia apetala* and *S. acida*

SPOROJUGLANDOIDITES JURASSICA GEN. ET SP. NOV., A SPOROMORPH FROM THE JURASSIC OF THE RAJMAHAL HILLS, BIHAR

By VISHNU MITTRE

Birbal Sahni Institute of Palaeobotany, Lucknow

Under the name *Sporojuglandoidites jurassica* a new sporomorph is described from the jurassic rocks of India. The sporomorph is distinguished by the presence of formainoid apertures on its body, character, not met with in any plant group except the anginoid apeartures on its body, a character not met with in any plant group except the angiosperms. In general character it seems to resemble the juglandoid grains..

PAPERS READ AT THE SYMPOSIUM ON "CONSTITUTION OF STARS"

1. Presidential Address by Prof. A. C. Banerji, Vice-Chancellor, University of Allahabad.

2. Exchange potential and mass-radius relations of cold bodies by Pyare Lal and P. L. Bhatnagar, St. Stephen's College, Delhi.

3. Method of separation in astrophysical problems by G. Bandopadhyay, Indian Institute of Technology, Karagpur.

4. Evolution of stars on the upper main sequence by R. S. Kushwaha, Princeton University Observatory, Princeton, New Jersey. (U. S. A.).

5. A possible interpretation of the H. R. diagram for the plediodes based on modern theory of stellar structure by A. G. Massevitch, Moscow.

6. Evolutionary trends in close binary systems by Z. Kopal, Department of Astronomy, University of Manchester.

7. On the evolutionary connection between stars and nebulae by V. P. Ambartsumian, Bjurakan Astrophysical Observatory of the Armenian Academy of Sciences.

8. A pectropgraphic study of HD 21449 by M. K. Vainu Bappu and S. D. Sinvahal, U. P. Government Astronomical Observatory, Naini Tal.

9. Inferences concerning thermonuclear reactions drawn from the theory of internal constitution by H. Bondi, Trinity College, Cambridge.

PAPERS READ AT THE SYMPOSIUM ON "FLOODS AND THEIR CONTROL"

1. Introduction by Prof. S. Ghosh, Head of the Department of Chemistry, University of Allahabad.

2. Presidential Address by Prof. M. N. Saha, Director, Indian Association for the Cultivation of Science, Calcutta.

3. Flood control in India and the role of hydraulic models in the design of flood control works by D. V. Joglekar, S. C. Desai, S. V. Chitale and S. D. Pansalkar, Central Water and Power Research Station, Poona.

4. Flood control in the Damodar Valley by N. S. Iyengar and R. J. Prasad, Damodar Valley Corporation, Hazaribagh.

5. Floods and their control by G. S. Mathuda, Forest Research Institute, Dehra Dun.

6. Floods and their control by S. C. Pandeya, Department of Botany, Mahakoshal Mahavidayalaya, Jabalpur.

7. Proper land use for reducing flood crests by S. P. Teotia, Soil Conservation Department, Damodar Valley Corporation, Hazaribagh.

8. A note for the symposium on flood control by S. P. Chaterjee, Department of Geography, University of Calcutta.

9. Flood control by C. L. Dhawan, Irrigation and Power Research Institute, Amritsar.

10. Floods and their control by H. L. Uppal, Irrigation and Power Research Institute, Amritsar.

11. A note on Symposium on floods and their control in Mysore state, by Commissioner of Economic Development and Planning, Bangalore.

12. History of flood protection in India by P. R. Ahuja, Central Water and Power Commission, New Delhi.

13. Afforestation and soil conservation in relation to flood protection by P. R. Ahuja, Central Water and Power Commission, New Delhi.

PAPERS READ AT THE SYMPOSIUM ON "PHYSICS OF SOLID STATE"

1. Introduction by Prof. K. Banerji, Head of the Department of Physics, University of Allahabad.

2. The polarization field in an Ionic crystal and its influence on the reststrahlen frequency by K. S. Krishnan and S. K. Roy, National Physical Laboratory, Delhi.

3. On the study of elasticity and some other properties of crystals by diffuse X-ray reflections by W. A. Wooster, Crystallographic Laboratory, Cavendish Laboratory, Cambridge.

4. Temperature dependence of the diamagnetic anisotropy of Benzil by M. Leela and K. Lonsdale, Department of Crystallography, University College, London.

5. Phase transitions in crystals composed of organic molecules with methyl groups at the molecular peripheries by Masanobu Momotani, Hiroshi Suga, Syuzo Seki and Isamu Nitta, Faculty of Science, Osaka University, Osaka.

6. Scattering of X-rays by defect structure by W. Cochran, Cavendish Laboratory, Cambridge.

7. Determination of elastic constants from the studies of the thermal diffuse x-ray scattering of single crystals by the photographic method by R. K. Sen, Central Jute Technological Resarch Institute, Calcutta.

8. Recent investigations into the structure of cellulose and cellulosic fibres by M. K. Sen, Indian Jute Mills Research Institute, Calcutta.

9. On the thermoluminiscence and trappings mechanisms of alkalihaldes by H. N. Bose and A. L. Laskar, Indian Institute of Technology, Kharagpur.

10. Lattice disorders in kaolinite by G. B. Mitra and M. G. Basak, Department of Physics, Indian Institute of Technology, Kharagpur.

11. Space group O-phthalic anhydride by Kesto Chandra Banerji, Department of Physics, University of Allahabad.

PAPERS READ AT THE SYMPOSIUM ON "ROLE OF HORMONES IN GROWTH AND REPRODUCTION"

1. Presidential Address by Prof. Shri Ranjan, Head of the Department of Botany, University of Allahabad.

2. Hormones and Reproduction in Acidians by S.M. Das, Department of Zoology, Lucknow University.

3. Effect of hormones on the rooting of isolated leaves by B. Samantrai, Department of Botany. Ravenshaw College, Cuttack.

4. Effect of β-Indolylbutyric Acid on the growth of isolated leaves by B. Samatarai and S. K. Sinha, Department of Botany, Ravenshaw College, Cuttack.

5. Influence of some plant growth substances on several phytopathogenic fungi by K. S. Gopalkrishan, Hindusthan Antibiotics, Pimpri.

6. Role of hormones in growth and Reproduction by S. N. Luktuke, Division of Animal Genetics, Indian Veterinary Research Institute, Bareilly.

7. Physiological responses in water hyacinth as a result of treatment with methoxene by B. K. Kar, Jute Agricultural Research Institute, Barrackpore.

8. Hormones in relation to the development of seedless fruits by R. S. Choudhuri, R. Rajagopal and S. Mahadevan, Agricultural Botany Research Laboratory, Banaras Hindu University, Banaras.

9. Influence of thyroid status upon the functional activities of male reproductive organs by B. Mukherji, Central Drug Research Institute, Lucknow.

10. Use of hormones in human growth and reproduction by B.B. Bhatia and K. B. Kunwar, M. G. M. Medical College. University of Lucknow, Lucknow.

11. Role of hormones in Sexual reproduction in algae by A. K. Mitra, Department of Botany, University of Allahabad.

12. Effect of some synthetic growth regulating subtances on the rooting of marcots of *Psiduim guajava* L by N. S. Parihar, Department of Botany, University of Allahabad.

PAPERS READ AT THE SYMPOSIUM ON "ROLE OF PHOSPHATES IN THE SOIL, PLANT AND ANIMAL KINGDOM"

1. Clacium phosphates and their importance in nitrogen fixation and alkali soil reclamation-Presidential Address by Prof. N. R. Dhar, Sheila Dhar Institute of Soil Science, University of Allahabad.

2. Chelation by organic substances-A factor in phosphate availability Joseph E. Steckel and Dale H. Sieling, University of Massachusetts, Amherst, Massachusesetts.

3. Some problems concerning soil organic phosphorus by Armi Kaila, Department of Agricultural Chemistry, University of Helsinki, Helsinki, Finland.

4. Mechnism of lime saving by the applications of phosphates by N. R. Dhar and S. G. Misra, Sheila Dhar Institute of Soil Science, University of Allahabad.

5. Composition of different types of bone meals and effect of particle size on the available phosphoric acid content by A. B. Ghosh, B. K. Chibber, M. A. Idnani and S. P. Raychaudhuri, Indian Agricultural Research Institute, New Delhi.

6. Effect of different phosphates on the manurial value of anaerobically fermented cowdung in the production of combustible gas by Abhiswar Sen, N. R. Paul and R. B. Bewari, Indian Agricultural Institute, New Dlelhi.

7. Application of high levels of phosphates to red soils-studies on their effect of phosphorus status and crop yields by B. V. Venkata Rao and S. V. Govindarajan, Division of Agricultural Chemistry, Department of Agriculture, Bangalore.

8. Effect of phosphoric acid on leaching of lime by N. R. Dhar and K. N. Goel, Sheila Dhar Institute of Soil Science, University of Allahabad.

9. The role of phosphate in glycolysis and synthesis of poly-and di-saccharides in green gram (*Phaseolus radiatus*) by K. V. Giri and T. Ramasarma, Department of Biochemistry, Indian Institute of Science, Bangalore.

10. Hypothroidism and phosphate-Metabolism in seminal vesicles by J. S. Rawat and A. Roy, U. P. College of Veterinary Science and Animal Husbandry, Mathura.

11. Mineralisation of organic phosphorus under tropical conditions-Effect of plant growth on mineralsiation by S. N. Saxena and S. Kashinathan, College of Agriculture, Banaras Hindu University.

12. Adsorption of monocalcium phosphate by soils, bentonites, lignite hydrated oxides and oxides of iron, aluminium and chromium by N. R. Dhar and S. G. Misra, Sheila Dhar Institute of Soil Science, University of Allahabad.

13. Effect of phosphate fertilizations on wheat Sushil Kumar Bajpai, Botany Department, University of Allahabad.

14. Role of phosphorus in the soil, plant and animal kingdom by S. Das, Ex-Chief Chemist, Indian Agricultural Research Institute, New Delhi.

15. Phosphate and Crop production by N. D. Rege, Assistant Soil Conservation Officer, Government of India Research Centre, Ootacamund.

16. Mechanism of phosphate leaching from Soils by N. R. Dhar and S. G. Misra, Sheila Dhar Institute of Soil Science, University of Allahabad.

17. Effect of phosphate on microbiological activities in soils by P. C. Thakur, N. D. Vyas and Abhiswar Sen, Division of Chemistry, Indian Agricultural Research Institute, New Delhi.

18. A method of separation and identification of inositol phosphates of soil by anion exchange chromatography by S. N. Saksena and S. Kashinathan, College of Agriculture, Banaras Hindu University.

19. A study of phosphrous nitrogen relationship in sagar soils by S. N. Banerjee and O. N. Tripathi, Department of Chemistry, University of Sagar.

20. Studies on nutrient deficiency and their interrelationship in plant growth-Maize Crop by M. Sanyasi Raju and T.R. Subrahmanyam, Agricultural of College and Research Institute, Coimbatore.

21. Organic phosphorus content as an index of fertility of some Indian soils by S. N. Saxena and S. Kashinathan, College of Agriculture, Banaras Hindu University.

22. Effect of phosphates on nitrogen loss by N. R. Dhar and L. K. Nagpal, Sheila Dhar Institute of Soil Science, University of Allahabad.

23. Nitrate formation and fixation of atmospheric nitrogen in alkali and normal soils on the addition of organic substances containing small amounts of phosphates by N. R. Dhar and S. K. Pal, Sheila Dhar Institute of Soil Science, University of Allahabad.

24. Role of phosphates in plants by Niranjan Das, Botany Department, University of Allahabad.

25. Retarding effect of lignite and different phosphates on the nitrogen loss in soils by N. R. Dhar and T. N. Chojer, Sheila Dhar Institute of Soil Science, University of Allahabad.

26. Influence of nitrification on the availability of phosphates by N. R. Dhar and T. N. Chojer, Sheila Dhar Institute of Soil Science, University of Allahabad.

27. Effect of mineral phosphates on nitrogen fixation effected by the oxidation of lucerne by N. R. Dhar and Pritam Singh, Sheila Dhar Institute of Soil Science, University of Allahabad.

28. Effect of dicalcium phosphate and organic matter on nitrogen loss in soils by N. R. Dhar and Pritam Singh, Sheila Dhar Institute of Soil Science, University of Allahabad.

29. Contribution a l'etude de lastructure physique fine des phosphates naturels de chanx by F. Carbona and J .L. Cuzin, International Superphosphate Manufacturer's Association, Paris.

30. Adsorption of phosphate on titanium dioxide and ilmenite by N. R. Dhar and K. M. Verma, Sheila Dhar Institute of Soil Science, University of Allahabad.

31. Phosphates in relation to the growth of algae by A. K. Mitra, Botany Department, University of Allahabad.

32. Phosphate fixation contra phosphates availability by Alfred Aslander, Royal Institute of Technology, Stockholm, Swden.

33. Comparative value of Indian rock phosphates and basic slags by N. R Dhar and D. Sharma, Sheila Dhar Institute of Soil Science University of Allhabad.

34. Investigations in aluminium and other sparingly soluble phosphates, rock phosphates and basic slag by N. R. Dhar and D. Sharma, Sheila Dhar Institute of Soil Science, University of Allahabad.

35. Influence of Calcium carbonate and some oxides on the solubility of sparingly soluble phosphates by N. R. Dhar and D. Sharma, Sheila Dhar Institute of Soil Science, University of Allahabad.

36. Influence of some salts upon the P_2O_5 solubility of sparingly soluble phosphates by N. R. Dhar and D. Sharma, Sheila Dhar Institute of Soil Science, University of Allahabad.

37. Studies in lime-phosphoric acid and magnesia phosphoric acid neutralization by N. R. Dhar and D. Sharma, Sheila Dhar Institute of Soil Science, University of Allahabad.

38. Studies in hydrous aluminium oxide-phosphoric acid and hydrous ferric oxide-phosphoric acidrneutralization by N. R. Dhar and D. Sharma, Sheila Dhar Institute of Soil Science, University of Allahabad.

39. Influence of different phosphates in compositing of wheat-straw, saw dust and mixtures of sawdust with straw and dung by N. R. Dhar and A. C. Gour, Sheila Dhar Institute of Soil Science, University of Allahabad.

40. Studies in titanium, iron, calcium, strontium, barium zinc and manganese phosphates by N. R. Dhar and K. M. Verma, Sheila Dhar Institute of Soil Science, University of Allahabad.

41. Studies in phosphorylation by N. R. Dhar and G. P. Ghosh, Sheila Dhar Institute of Soil Science, University of Allahabad.

APPENDIX I

HONORARY FELLOWS ELECTED ON THE OCCASION OF THE SILVER JUBILEE

1. PANDIT JAWAHARLAL NEHRU,
Prime Minister of India.

Pandit Nehru is one of the greatest men of the present age, a champion of oppressed people, a staunch upholder of democracy and has been man of unusual courage and indomitable spirit. He has been elected an Honorary Fellow of this Academy for putting India on the scientific map of the world by establishing a chain of National Laboratories.

2. PANDIT GOVIND BALLABH PANT,
Home Minister of the Government of India.

Pandit Pant is chiefly responsible for the all round development of Uttar Pradesh. He has taken a lifelong interest in the advancement of education and presided over the deliberation of the 17th. Session of the Academy. He has been elected an Honorary Fellow of this Academy for his untiring efforts for raising the standard of education in Uttar Pradesh.

3. DR. SAMPURNANAND,
Chief Minister of Uttar Pradesh.

Dr. Sampurnanand, himself a teacher for a long time, has taken a fatherly interest in the progress and growth of this Academy. His deep appreciation of the value of science in the modern world can be judged by his presidential addresses to the 8th. and 19th. session of this Academy. He has been elected an Honorary Fellow of this Academy in recognition of his great services for the cause of education and research in Uttar Pradesh.

4. PROF. W. BROWN,
Emeritus Professor of Botany, Imperial College of Science and Technology, London.

Professor Brown has been responsible for detailed physiological studies of fungi and his experiments have thrown light on the physiology of host parasite relationship

as well as on physiology of parasitsm in fungi. A large number of mycologists and plant pathologists of India have received their training under him. He has been elected an Honorary Fellow of this Academy for his contributions to the science of mycology.

5. PROF. WILHELM KLEMM,

Director, Institute of Inorganic Chemistry, University of Munster, Munster (West Germany).

Professor Klemm's researches in the field of Inorganic Chemistry have been many and varied. He has studied conductivity of fused salts, compounds of rare earths, intermetallic compounds etc. He has been elected an Honorary Fellow of this Academy in recognition to his work on Magnetochemistry.

6. PROF. A. H. COMPTON,

Chancellor, Washington University, St. Louis, Illinois, (U. S. A.).

Professor Compton is one of the greatest authorities on atomic science at the present time. Since 1918 he has been engaged on the theoretical and experimental investigation of the dispersion of X-rays, which led to the discovery now known as the Compton Effect for which he received the Nobel Prize in 1927. He initia ted and directed development of the first atomic chain reaction and first quantity production of plutonium for which he has been elected an Honorary Fellow of this Academy.

7. PROF. R. E. GRIM,

Research Professor of Geology, University of Illinois, Urbana, Illinois, (U. S. A.).

Professor Grim is one of the authorities on the difficult science of clay mineralogy and has elucidiated the structure of most of the clay minerals. He has been elected an Honorary Fellow of this Academy in recognition to his researches on the structure of clay minerals.

8. PROF. THEODOR SVEDBERG,

Director, Gustaf Werner Institute of Nuclear Chemistry, University of Uppsala, Uppsala. (Sweden).

Professor Svedberg is the father of Physical Chemistry in Sweden and has made fundamental contribution to the science of colloids and high polymer chemistry. He has developed a remarkable Ultracentrifuge for the determination of the size of the colloidal particles and protein molecules, in recognition of which he has been elected an Honorary Fellow of this Academy.

9. PROF. MANNE SIEGBAHN,

Director, Nobel Institute for Physics, Stockholm (Sweden).

Prof. Sieghbann is an authority on X-ray spectroscopy and has investigated in a thorough and systematic manner X-ray spectra of a number of elements, which led to the discovery of a number of new lines. He overcame the difficulties connected with the search for longer wave-lengths by designing and constructing a high vacuum spectrograph. He has been elected an Honorary Fellow of this Academy for his comprehensive and successful investigations in the field of X-ray spectra.

10. PROF. PAUL KARRER,

Professor of Inorganic and Organic Experimental Chemistry, Faculty of Philosophy II, Chemical Institute, University of Zurich, Zurich. (Switzerland).

Prof. Karrer has published over 900 papers in various branches of Organic Chemistry. He has discovered a special process to aminise cellulose and to produce amine theread permitting of a new insight into the nature of dyeing processes. He has studied Vitamin A, Vitamin C, lactoflavin and hydrogen transferring group of cohydrases. He has discovered new anthocyanins and established the constitutions of many vegetable dyes. He has been elected an Honorary Fellow of this Academy in recognition to his fundamental work on vegetable dyes.

11. PROF. LINUS PAULING,

Chairman, Division of Chemistry and Chemical Engineering and Director of Gates and Crellin Laboratories of Chemistry, California Institute of Technology, Pasadena 4, California. (U. S. A.).

Professor Pauling's researches have included studies on the determination of the structure of crystals and molecules, application of quantum mechanics to chemistry, the rotation of molecules in crystals, the chemical bond, line spectra. He has advanced a theory of the structure and formation of antibodies, which has provided a basis for extensive investigations of the activity of serums. He has been elected an Honorary Fellow of this Academy in recognition to his fundamental work in the field of immunochemistry.

12. SIR E. J. RUSSELL,

Formerly Director, Rothamsted Experimental Station, Campsfied Wood, Woodstock, Oxfordshire (England).

Sir John Russell is one of the World' foremost soil scientist. He has been the Drector of Rothamsted Experimental Station for over 40 years and is chiefly responsible for the international reputation of this Institution. He has studied systemati-

cally the problems of nitrogen transformations. He has been elected an Honorary Fellow of this Academy for his writings on Soil Science and Agricultural Chemistry.

13. PROF. PAUL PASCAL,
Emeritus Professor of General Chemistry, Faculty of Science, University of Paris, Sorbonne, Paris (France).

Prof. Pascal is one of the greatest chemists of France and has done extensive research work on Magneto-chemistry, Metaphosphates and Nitrogen and its derivatives. He was elected an Honorary Fellow of this Academy in recognition to his work on Industrial Chemistry.

14. PROF. OTTO HAHN,
President, Max Planck Society for the Advancement of Science, Gottingen (Germany).

Prof. Hahn is an eminent radio-chemist of this generation and has outstanding scientific discoveries of immense range and scope to his credit. He carried out the separation of radium from barium and discovered radio-actinium, protoactinium etc. He has been elected an Honorary Fellow of this Academy in recognition to his valuable work in the field of radioactivity and nuclear physics.

15. PROF. S. A. WAKSMAN,
Director, Institute of Microbiology, Rutgers University, The State University of New Jersey, New Brunswick, New Jersey (U. S. A.).

Professor Waksman is one of the greatest living microbiologist to-day. His special field of work includes, the microbiological population of the soil, sulphur oxidation by bacteria, micro-organisms and soil fertility, decomposition of plant and animal residues etc. He has discovered a number of new antibiotics, which have found extensive applications in the treatment of numerous infectious diseases of men, animals and plants for which he has been elected an Honorary Fellow of this Academy.

16. SIR GUY A. K. MARSHALL,
Formerly Director, Commonwealth Institute of Entomology, London (England).

Sir Guy Marshall has done extensive work in general entomology and has specially added to our knowledge of locusts and locust control. Under his able guidance, the Commonwealth Institute of Entomology of which he was the first Director gained world wide reputation as the premier body of its kind in the world. He has been elected an Honorary Fellow of this Academy for his contributions to entomology.

17. PROF. HARLOW SHAPLEY,
Formerly Director, Harvard College Observatory, Cambridge 38, Massachussetts (U. S. A.).

Professor Shapley is one of the foremost astronomers of the present day. He has done considerable work on the Cephoid variable stars including the celebrated "Period-Luminosity Law" which enable us to measure the distances of galaxies and globular clusters. He has discovered a number of galaxies and has done notable work on photometry and spectroscopy. He has been elected an Honorary Fellow of this Academy for his contributions to different branches of astronomy.

18. PROF. D. H. MENZEL,
Director, Harvard College Observatory, Cambridge, Massachussetts, (U. S. A.).

Prof. Menzel's general field of investigation is astrophysics with specialization on the problems of the sun and interpretation of stellar and nebular spectra, planetary atmosphere, wave mechanics atomic spectra, theory of reactions and equilibrium at high temperature. The film "Explosion on the Sun" prepared under his direction is being shown and studied all over the World. He has been elected an Honorary Fellow of this Academy for his contributions to astronomy.

19. PROF E. C. TITCHMARSH,
Savillian Professor of Geometry, University of Oxford, Oxford (England).

Professor Titchmarsh has done considerable amount of research on the theory of functions, theory of Fourier Integrals, theory of Riemann Zeta-Function etc. He is one of the greatest mathematicians of England to-day and has been elected an Honorary Fellow of this Academy for his contributions to different branches of mathematics.

20. PROF. NIELS BOHR,
Director, Institute of Teoretical Physics, University of Copenhaggen, Copenhagen, (Denmark).

Professor Bohr is one of the greatest theoretical physicists of the present day. He greatly extended the theory of atomic structure when in 1913, he devised an atomic model and showed that it could explain the spectra of elements and their position in the periodic table. He also developed the quantum theory and an important theory of nuclear structure. He has been elected an Honorary Fellow of this Academy in recognition to the significant role that he played in the development of atomic energy.

21. PROF. GABRIEL BERTRAND,

Honorary Professor of Biochemistry, University of Paris and Head of the Department of Chemical Biology, Pasteur Institute, Paris (France).

Prof. Bertrand is an outstanding chemist of France. The vast range of subjects in which he has worked can be judged from the inscription on the Medal which was issued by his students on the occasion of his 70th birthday. He has been elected an Honorary Fellow of this Academy in recognition to his contributions to Chemical Biology.

22. PROF. ARNE TISELIUS,

Professor of Biochemistry, Institute of Biochemistry, University of Uppsala, Uppsala, (Sweden).

Prof. Tiselius has made systematic study on the physical properties of proteins, particularly by electrophoresis. He has studied adsorption and diffusion phenomenon in zeolite crystals and has devoted considerable amount of attention to the development of adsorption chromatography . He has been elected an Honorary Fellow of this Academy in recognition to his classical work on the physico-chemical properties of proteins.

23. PROF J. N. COUCH,

Kennan Professor and Chairman of the Department of Botany, University of North Carolina, North Carolina (U. S. A.).

Prof. Couch is one of the most eminent mycologists of the United States. His numerous contributions on the morphology and cytology of a large number of lower fungi, especially Chytridiales have been published in noted scientific journals. He has been elected an Honorary Fellow of this Academy for his distiguished contributions to mycology.

24. SHRI HARGOVIND SINGH,

Minister for Education, Uttar Pradesh.

Shri Hargovind Singh has taken a prominent part in the struggle for Indian Independence and is remodelling the pattern of education in Uttar Pradesh. In his Presidential Address to the 22nd session of this Academy, he outlined the role of scientists in Independent India. He has been elected an Honorary Fellow of this Academy in recognition to his services to the cause of education in Uttar Pradesh.

APPENDIX II

SUMMARIES OF POPULAR LECTURES

ANCIENT INDIAN MEDICINE AND MODERN DRUG RESEARCH

By DR. B. MUKERJI,

Director, Central Drug Research Institute, Lucknow

In all countries with an ancient civilization, such as India, China, Egypt and others, a system of medicine indigenous to the particular place exists and in some places it is still catering to the needs of a large section of the local population. Due to the passage of times, many changes have taken place. Though excellent records are available, it may be said without any fear of contradiction that much empiricism and superstition has been absorbed in the original core of ancient medicine during the course of centuries. This is particularly true of Ayurvedic medicine in India. In this system, as many as 2,200 medicinal plants have been recommended as being useful in some condition or other. From the scientific point of view it seems desirable to investigate into the properties of this rich store of Indian materia medica. The discovery of Ephedrine from ancient Chinese herbs, of tubocurarine from ancient African and South American folk-lore medicine and of Reserpine from Indian '*Rauwolfia serpentina*' indicates that a systematic study in this field may be awarding.

In India, the study of indigenous materia medica according to the modern scientific lines was started some 40 years ago and some progress has been made in the direction of survey and botanical identification of medicinal plants, study of chemical constituents and general pharmacological action of some of the constituents isolated of more reputed remedies. The problem has been approached from the following angles :

(i) Investigation of the possibilities of utilisation of pharmacopoeial and allied drugs growing in India in place of the 'official ones' mentioned in the British Pharmacopoeia and other recognised pharmacopoeias. This led to the finding of several allied species of plants of known value, such as the various species of Hydnocarpus, Indian Senega, Indian Digitalis, Belladona, Squill, Gentian, Rhubarb, etc. as substitutes for the corresponding pharmacopoeial species ;

(ii) The trial of specifics for various diseases, such as Holarrhena, Rauwolfia, Butea, Alsatonia, Caesalpinia, Adhatoda, Punarnava, Melia, etc.,

for dropsy, dysentery, malaria, etc. Some of these have received widespread attention and are adopted in modern medicine while others have been discarded as being of little value ;

(iii) The research for new active principles, especially drugs of alkaloidal character, glucosides, tannins, etc., such as Ephedrine, Ajmaline, Berberine, etc ; and

(iv) New sources of therapeutic agents of proven value, such as the various solanaceous plants used in the preparation of atropine, and new sources of Santonin, Ephedrine, etc.

Scientific investigation of indigenous drugs is a problem of a complex character. From the expirical knowledge of a crude drug to its use in the rational scientific medicine, is a long way and must pass through (1) botanical identificiation ; (2) chemical examination ; (3) pharmacological and toxicological assay ; and (4) chemotherapeutic and clinical trials. It is sometimes convenient and less time consuming to start from clinical trials first and then proceed to further laboratory study and analysis. In whatever manner the investigative approach on indigenous drugs is made, successful or even satisfactory work is time-consuming and requires a 'team-work' of several groups of scientists, each expert in his own fields of specialisation but integrated and coordinated for solution of one or other problem at one time. No haphazard methods of approach by individuals or even by single institutions with inadequate resources are likely to succeed.

The problem of research on indigenous drugs is likely to be of considerable interest to India and to all near and far-east countries. Close affinities in the occurrence and distribution of similar medicinal plants are evident in these regions. Success would mean cheap and effective medicines to maintain the health status of millions of poor inhabitants of these zones of the world.

ATOMIC EXPLOSIONS AND WEATHER

By S. BASU,

Director-General of Observatories, New Delhi

Since the explosion of the first atomic bomb and during the subsequent trials of atomic explosions, very divided opinions have been expressed, often in newspapers, regarding the possible connection between these atomic test explosions and the abnormalities in the weather of the seasons following them. Speculation was particularly active following the abnormal weather that prevailed in western Europe in mid-1954, soon after the announcement that a series of thermonuclear explosions had taken place in the Pacific.

The presumption in most cases is (1) that the great amount of energy released during a thermonuclear bomb explosion can bring about changes in the atmosphere which would modify the weather ; other suggestions put forth are (2) that the atomic debris might serve as a cloud seeding agent; (3) that the radioactive debris might change electric conductivity and potential gradient of the atmosphere, and that this in turn might produce changes in the weather elements ; or (4) that the dust thrown up in atomic explosions might reduce the amount of solar radiation reaching the earth.

A casual examination of some of the recent climatic data, e.g. that of mid-1954, might appear to suggest the possibility of "cause and effect" between the anomalous weather and atomic explosions. But a careful and more objective examination of the factors mentioned above does not, however, support the hypothesis that atomic explosions have changed the weather.

Enquiry into this subject has proved of importance alike to the meteorologist, the layman and the men in authority. Very appropriately, therefore, the World Meteorologial Organisation has been collecting information from its members about atomic explosions and climatic effects. The enquiry is not yet complete, and the present state of the analysis of meterological data renders it unlikely that a firm conclusion can be reached ; but when the best available observational evidence and the most plausible theories are considered together, there appears to be no reason for believing that the past thermonuclear trial explosions have been responsible for any world-wide extremes of weather.

It may, therefore, be said, combining conviction with caution, that while there are good reasons for believing that occasional thermonuclear explosions is in the present scale can have very localised and transient weather effect (this will be illustrated from photographs of the Second Bikni underwater bomb explosion of July 1946), all argument so far used in favour of more widespread and longterm effects of these explosions on the weather have been merely intuitive or based on misleading analogies.

THE BIRTH OF THE HIMALAYA

By PROF. W. D. WEST,

Head of the Department of Geology, University of Saugar

The evolution of the earth's surface and of the life that has lived on it during the past 500 million years can be deciphered in broad outline from the record of the rocks. Not only is the story of the evolution of life through the ages made clear from the fossil remains found embedded in the rocks, but some idea can also be gained of the past geography of the earth's surface, the distribution of the ancient seas and land masses, and the birth and decay of the mountains.

The study of mountain ranges reveals several interesting facts. Firstly, the geological record shows that they have been formed at more than one period of the earth's history, examples from India being the old Aravalli chain and the modern Himalayan range. It seems as though the earth in its history has behaved in a rhythmical manner, short bursts of activity, when the crust has been crumpled to form mountains, being followed by much longer periods of relative quiescence. Secondly, it is found that at each period of activity mountain formation has been confined to certain restricted zones of the earth's surface. Thirdly, mountains are mostly formed of sediments that had been deposited in shallow basins, the long continued sinking of which had lead to the accumulation of enormous thicknesses of sediment. These facts need to be explained before a satisfactory theory of the origin of mountains can be advanced.

When the structure of the major mountain systems of the world is studied it is found that the rocks forming them have been severely folded and fractured. This can only mean that the rocks have been compressed by some horizontal force. The cause of this compression, however, is still a mystery, though many theories have been advanced to account for it. The orthodox view is that the compression has been due to the contraction of the crust as the earth has cooled. But it is difficult to understand why such contraction should have taken place periodically and not continuously, and why its effects should have been localised along particular zones instead of uniformly over the earth's surface.

A spectacular theory that has gained some support, though it has also been severely criticised, is that the continental masses behave as though floating in a plastic substratum which directly underlies the ocean floor and extends beneath the continents, and that in the past an original single land mass broke up, the fragments drifting apart and causing the compression of the softer zones of the crust to form the mountain ranges. A third theory is that their formation has been due to convection currents set up in the heated substratum below the crust, and caused in part by the heat generated by the radioactive content of the rocks. The flow of such currents would exert a powerful drag on the solid crust, causing the weaker zones to crumple. It is a process, moreover, that might well be periodic.

Considering now the geological history of the Indian region, some 50 million years ago pennisular India had much the same outline as it does to-day, except that the sea had spread some way over what is now Saurashtra and Cutch, and over the coastal tracts of Orissa and Madras. But to the north, along what are now the northern slopes of the Himalaya and the mountains of Baluchistan, there was an extensive though shallow sea, an arm of which spread across Kashmir and along the site of the future lower Himalaya to as far east as the position of Simla. There then occurred a remarkable event, the extrusion of enormous quantities of volcanic lava, the remanants of

which now cover much of western India. The molten rock came up through narrow fissures in the crust, welling out over the land surface, flow upon flow, to a thickness of several thousand feet. There was little explosive action, and the crust throughout must have been in a state of tension. These eruptions may have lasted several million years, and the volume of lava extruded must have been of the order of 250,000 cubic miles. This was followed by a period of compression, whereby the thick mass of sediment, of the northern sea deposited over a long period in a continuously sinking basin, and containing the fossil remains of marine animals as they evolved from the earliest types to those of the present day, was slowly compressed, leading eventually to the disappearance of the sea and the emergence of land. The sediments were severely folded and fractured, older rocks in places being forced over younger, until a shortening of the earth's crust of the order of 100 miles had been effected.

This sequence of events-a period of tension followed by a period of compression is not at present completely understood, though it must have a fundamental significance ; and whatever explanation is eventually forthcoming must throw important light on the origin of mountain ranges.

Detailed studies of the structure of the Himalaya reveal that the formation of the range took place in several stages. As the land emerged in the north, the sea was forced to migrate southwards, receiving, the debris removed by denudation from the rising mountains. At each stage of the compression the deposits of the northern side of the sea were folded and upraised, and we are presented with the picture of a southward advancing range attaching to itself deposits that were derived from its own denudation. As the compression intensifled the folded sediments were also fractured, the rocks to the north being thrust over those to the south. Towards the end the shallowing sea became a network of freshwater lakes, the deposits of which were finally uplifted to form the Siwalik hills bordering the Himalayan range on its south, containing the fossil remains of land animals that were living when early man had just arrived upon the scene.

In this compression we have to visualize the relatively stable mass of peninsular India moving north against the mass of central Asia and compressing the soft marine sediments that had been accumulating in the sea that lay between, the two approaching masses meeting each other like the jaws of a closing vice. Not only where these sediments compressed, but the northern edge of peninsular India fractured and got incorporated in the rising mountain range. Thus the Himalaya are composed partly of rocks that had been deposited in the northern seas, and partly of the much older rocks of the northern edge of the peninsula.

Towards the end the horiznotally acting forces that caused the compression of the rocks died out, and there followed a period of vertical uplift that gave the range

its present elevation. Finally, the work of rain, rivers and glaciers carved out the surface to produce the snow-capped peaks and deep ravines of the present Himalaya, the grandest feature on the earth's surface.

INDIA—THE HUNGRIEST COUNTRY IN THE WORLD

By PROFESSOR N. R. DHAR,
Director, Sheila Dhar Institute of Soil Science, University of Allahabad

In a popular lecture to the Jubilee Session of the National Academy ofSciences, India, held at Lucknow on 26th December 1955, Professor N. R. Dhar stated that there is no major nation in the world as ill-fed and suffering from malnutrition as India.

Hunger, being the oldest enemy of man, has to be fought ruthlessly by every nation, specially by the Eastern people who are definitely underfed and suffer from malnutrition. Hence, improvement of land fertility is of supreme importance to mankind because the food situation is still unsatisfactory in the majority of countries of the world including India (which has the lowest food standard), Pakistan, Ceylon, Burma, China, Japan, most parts of South America, Egypt, Turkey, Italy, Greece and even the U. S. S. R. where the animal protein intake is still below the standard. This is evident from the following table :—

Country	Population in Millions	Calorie	Animal Protein (gms)
1. India	366	1,620	5.6
2. Ceylon	7.94	1,880	10
3. Philippines	21.04	1.960	9.6
4. Japan	84.9	1,970	11.8
5. Pakistan	80	2,020	11
6. China	450	2,050	11
7. U. S. S. R.	205	3,020	25
8. United Kingdom ..	50.4	3,080	43.4
9. Sweden	7.16	3,090	59
10. U. S. A.	155.5	3,117	60.7

In order to improve the world food situation the western nations utilize artificial nitrogenous fertilizers. In the east where majority of human beings of the world subsist, artificial fertilizers are practically unknown. Even before the last world war the amounts of artificial nitrogen used per acre in lbs. were small as is evident from the following table :—

Belgium (28.5), Holland (24.8), Germany (15.6), Denmark (10.3), Norway (6.0), Sweden (5.24), Itlay (4.3), France (4.0), Great Britain (2.5), U. S. A. (1.36), Poland (0.73) and Hungary (0.15).

It is clear, therefore, that the amounts of artificial nitrogenous matter used even by the industrially advanced nations is much less than that required for one good crop per year. The chief reason for this inadequate supply of artificial nitrogen seems to be the high cost of nitrogenous fertilizers in comparison with fertilizers such as superphosphate or potash. As the efficiency of the existing industrial methods of fixing atmoshperic nitrogen is low, the cost of production has been high. The *arc* method of fixing atomospheric nitrogen by passing electric discharge has an efficiency of 1—2 per cent, i.e. 98 or 99 per cent. of electric energy put in this process is wasted. Hence, this method has been completely abandoned all over the world. The Haber-Bosch method, which has been adopted in most countries today including the Sindri Plant in India, has an efficiency of about 8 per cent. i.e. 92 per cent of the energy put in the manufacture of ammonia or urea is wasted. The third method, known as the Cyanamide Method, was largely used in Germany. But the cyanamide, when added to soil, kills the bacterial population present in the soil. Moreover, the efficiency of this method is not high and is of the same order as that of the Haber-Bosch process. In 1938 the amount of nitrogen fixed industrially in the whole world was approximately 3.54 million tons of nitrogen. Even in 1950 the increase of fixed nitrogen has been only 3 per cent. over the 1938 figure showing that the expansion of the nitrogen fixation industry has been very small during a period of 12 important years in world history. This is certainly due to inherent difficulties in the nitrogen fixation industry and the high cost of production.

The world production of cereals today is approximately 600 million tons. The good food materials are produced to the extent of 400 million tons. For obtaining these food materials 100—150 million tons of nitrogen in the form of nitrogenous compounds are needed. But the industrial production of fixed nitrogen is only approximately 4 million tons per year. Hence, chemical technology has failed completely to cope with the world food situation by an adequate supply of nitrogenous compounds.

In order to improve the land fertility, therefore, specially in poor countries, we have carried on systematic and extensive research work on the problem of nitrogen

fixation and nitrogen loss and reclamation of alkali soils in the Chemistry Department and in Sheila Dhar Institute of Soil Science, University of Allahabad, since 1930.

From our researches carried out on the problem of atmospheric nitrogen fixation in soils on the addition of various types of organic substances for over 25 years we concluded that these compounds do not only add colloidal substances to the soil and improve the tilth and crumb formation and water retention capacity of the soil but they undergo slow oxidation in the soil and liberate energy which is utilized in fixing atmospheric nitrogen and enrich the soil from the nitrogen viewpoint. Moreover, the carbonaceous and non-nitrogenous compounds in the soil preserve the nitrogenous compounds present in the soil or added to it just as carbohydrates and fats act as protein sparers in the animal body.

We have discovered the influence of light in nitrogen fixation and nitrogen loss in soils and also the relationship between the nitrogen and phosphate status of soils. Phosphates help markedly the nitrogen fixation in soils by oxidation of organic matter. Light is actually utilized in land improvement because there is greater fixation of atmospheric nitrogen in the oxidation of organic matter than in the dark. Soils rich in phosphate have been found to be rich in nitrogen also.

By the use of organic matter mixed with basic slag, powdered phosphate rock, bone powder, dicalcium and tricalcium phosphates, the efficiency of nitrogen fixation, i.e. the amount of nitrogen fixed per gram of carbon oxidisd, is greatly increased. We have used this mixture very successfully in the reclamation of alkali lands in different parts of India. Moreover, the efficiency of our method of fixing atmospheric nitrogen is about three times better than the industrial method and our method is almost as efficient as the nitrogen fixed under natural conditions by legumes. Moreover, our experiments and results have clearly explained the enormous increase of soil nitrogen by the yearly addition of dung observed in Rothamsted and other Experimental Stations. When inorganic nitrogenous fertilizers are used there is no improvement in nitrogen content in the soil, but, in many cases, there is marked deterioration with time. Also, we have clearly explained why the recovery of nitrogen in crops from the addition of nitrogen fertilizers never exceeds 50 per cent and also the marked loss of nitrogen when virgin soils are broken up for cultivation. And, we have clearly established that a mixture of farmyard manure or straw and artificials is better than artificials alone.

Moreover, in compositing plant materials for obtaining humus, superphosphate, calcium phosphate, finely ground phosphate rocks and basic slag have been found beneficial in fixing atmospheric nitrogen and stabilising the total nitrogen in such composts.

Hence, we have experimentally shown that the future of land improvement and alkali soil reclamation all over the world depends on greater utilization of all kinds of organic substances like dung, leaves, grass, legumes, straw, sawdust lignite etc. mixed

with basic slag or soft phosphate rock. For permanent agriculture, organic substances aided by phosphates seem to be the soul of soils and must be intensively utilized as they supply nitrogenous compounds and potash and make phosphates readily available to crops.

As the world population is increasing fast, the future of humanity certainly depends on an adequate and cheap supply of nitrogenous compounds for soil improvement and crop production and this has been possible by our researches which have drawn the attention of soil scientists and farmers all over the world. Today the economics of the majority of the nations in the East is the "Science of Human Misery" as stated by Karl Marx a century ago.

Many Indians may be expecting that a new era of plenty from the utilization of the atomic energy is likely to be ushered in for the benefit of the poor man. But, as atomic energy is still quite costly, this is not going to happen. Moreover, as the North-west European countries have followed the difficult path of experimentation for 500 years in obtaining knowledge, Russia for 200 years and India for only 50 years, the benefits from the atomic researches as well as from other scientific investigations should be directly proportional to the periods of time spent in the pursuit of knowledge. In other words, India can have only 1-10th of the benefit obtainable in North-west Europe and 1-6th of that in the U. S. S. R.

Morevoer, a scientific or a technical discovery made by a clever man working in isolation can only be utilized for the common man when the community as a whle is advanced enough to take up the matter seriously.

APPENDIX III

LIST OF DELEGATES

1. Prof. M. N. Saha, Director, Indian Association for the Cultivation of Science, Calcutta.
2. Shri S. Basu, Director-General of Observatories, Meteorological Office, New Delhi.
3. Dr. S. K. Ghosh, Central Glass and Ceramic Research Institute, Calcutta.
4. Shri Harish Chandra Saxena, Animal Nutrition Research Centre, Anand.
5. Dr. A. C. Joshi, Director of Education, East Punjab, Chandigarh.
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