Many scientists have adduced evidence to suggest that the algæ are able to fix the free atmospheric nitrogen. If this should prove to be true, the growth of the algæ must be encouraged on the fields.

The study of algæ is necessary in connection with town water supplies. In the reservoirs there is usually a fair amount of algal growth. The physical and chemical conditions of the water in the tanks and the nature of the algal population should be studied, and, when necessary, measures should be taken to check or altogether eliminate the growth of the algæ in order to ensure a pure water supply.

Many mosquito larvæ depend on algæ for their food and hence there is a possibility of checking the growth of the larvæ by controlling the growth of the algæ. It is reported that mosquito larvæ do not flourish in waters in which *Characeæ* are growing. If this should prove to be correct, then we have another method of getting rid of the larvæ.

Algæ are used as manure in Rajaputana, as they are very rich in nitrogenous material. It is not known whether they are used for a similar purpose in other parts of India. Characeous deposits are used as manure in Switzerland. Moreover, the peculiar odour emitted by them is said to help in keeping the soil free from insects.

M. O. P.

CHEMISTRY :

IN the first part of his address Prof. Neogi draws attention to an analysis of the causes which have led to the remarkable increase in the output of original work in chemistry throughout India during the last 20 years. Sir P. C. Ray along with Sir Alexander Pedlar and Dr. Richardson shares the glory of being among the pioneers of chemical research in India. Every paper of Sir P. C. Ray was commented upon by newspapers of the country, thirty years ago, as proof of the capacity of Indians for original work in chemistry but at the present day, only the most outstanding discoveries like Raman Rays attract the attention of the Indian public. The principal causes which have contributed to this change are: (1) the establishment of post-graduate departments in most Indian Universities ; (2) expansion and consolidation of purely research institutions like the Indian Institute of Science at Bangalore and technological departments in some Universities ; (3) establishment of industrial and scientific departments by provinces and native states ; (4) institution of the M.Sc. and D.Sc. degrees with fellowships and scholarships for research in many Indian Universities. But as important as any is the formation of the Indian Science Congress through the efforts of Professors J. L. Simonsen and P. S. MacMahon whereby different workers throughout the country were brought into touch with one another more closely and inspired the youth to emulate the work of the elders. Research has kept pace with the growth in opportunities for work, these thirty years. Dr. Neogi suggests the institution in Indian Universities of the Ph.D. degree for original work after M.Sc. stage, though still assisted by the teacher and pleads for greater help to the research student by a larger number of liberal research scholarships in Indian Universities, similar to those prevailing in the Indian Institute of Science at Bangalore.

The next portion of the address gives an account of optical isomerism as applicable to co-ordinated inorganic compounds. Optical isomerism was, as is well-known, explained by Le Bel and Van't Hoff in 1874 by the tetrahedral space arrangement of carbon linkages. In the next few decades, numerous classes of optically active compounds of elements other than carbon, such as N, S, P, As, B, Sn, Pb, Si and inorganic co-ordinated compounds of Co, Cr, Be, Pt, Ru, Rd, Ir and Pd were discovered and their isomerism explained by the newer conception of the arrangement of atoms in space. Werner was the pioneer in extending the conception of space representation to co-ordinated inorganic compounds. He and his co-workers soon discovered that (1) a co-ordination complex usually contains six monovalent groups round the central metal atom ; (2) compounds containing complex of the type $[MA_6]$ or $[MA_5B]$ do not exist as isomers ; (3) cis- and trans-isomerism exists in compounds containing complex of the type $[MA_4B_2]$ or $[MA_4BC]$; (4) In such cis-compounds if A_4 be substituted by two radicals, like oxalato or ethylenediamine, each occupying two co-ordinate positions in the complex, the compound will exhibit optical isomerism. In a complex of the type $[MA_6]$, A_6 be substituted by three radicals like oxalato or ethylenediamine, each occupying a double co-ordinate position, such complex will also exhibit optical isomerism.

The repeated occurrence of co-ordination number six among the complex salts led Werner to suppose that the substituents were placed at the corners of a regular octahedron having the central metal atom at the centre. He was able to prepare all the ten theoretically possible cobaltic-dinitro-ethylenediamine-propylenediamine compounds and all the twelve trispropylenediamine compounds in agreement with the octahedral structure. Varied and extensive experience and X-ray examination has overwhelmingly confirmed this view. The first optical isomers were isolated by Werner and Kling in 1911 and thus this branch of chemistry is only of 20 years' growth.

The first active co-ordinated inorganic compound contained cobalt as the central element. Soon Werner was able to isolate active complex compounds containing other elements of groups VI and VIII Cr, Fe, Ni, Ru, Rd, Pd, Ir and Pt. Recent work of Mills, Lowry, Wohl and others proves that elements of other groups, Cu, Be, Zn, B, Al and As also yield co-ordinated compounds. The resolution of hexol-dodecammine-tetracobaltic bromide $\{CO[CO(NH_3)_4(OH)_2]_3\}Br_6$ by Werner (1914) into *d* and *l* forms gave a blow to the belief that organic radicals are essential for optical activity in co-ordination compounds.

Both Le Bel and Van't Hoff postulated in the case of carbon compounds that, for optical activity to occur in a molecule, it must have at least one carbon atom attached to four different radicals. Later work as that of Pope, Perkin and Wallach (1909) on 1-methyl cyclohexylidene-4 acetic acid showed that the doctrine of the asymmetric atom is no longer a fundamental concept but is only a part of a wider truth. The successful resolution of cis- or tris-ethylenediamine or similar compounds which do not have any asymmetric atom, brought out

the fact that the indispensable condition for optical isomerism is that the molecule of the compound should be asymmetric and non-superposable with its mirror image. Thus Werner's work confirmed the inadequacy of the Le Bel and Van't Hoff's theory of the asymmetric atom.

In the resolution of racemic co-ordinate inorganic compounds all the three methods discovered by Pasteur have been tried. There is no record of any successful resolution by living organisms, bacteria or moulds. Only one instance of self-resolution by spontaneous crystallization is on record, *viz.*, that of Potassium Cobalti-oxalate by Jaeger and Thomas (1918). The remaining method, resolution by combination with active compounds, has been exclusively employed with inorganic compounds.

Search for an analogous compound of the tartaric acid type resulted in the discovery in 1913 by Werner of tetraethylenediamine-μ-intro-μ'-imino-dicobaltic-bromide which along with *d* and *l* forms, yielded a meso variety incapable of resolution. The phenomena of racemisation and mutarotation which have both been observed with active inorganic compounds, have not found lucid explanation and still await further work.

No comprehensive work has been done on the influence of solvents on the rotation co-ordinated compounds and work leading to a decision on the applicability of Landolt-Oudeman's Law to them is certainly desirable. Jaeger (1915) who examined their rotatory dispersion found that the form of the dispersion curve is dependent on the colour of the solution and chiefly on the complex.

But for some work by Werner, the phenomenon of Walden Inversion has been little studied in this group. The theories advanced for inversion of organic compounds may not be applicable here due to their octahedral structure and the absence of double bonds.

The phenomenon of geometrical inversion which has engaged the attention of Dr. Neogi in recent years has been dealt with at length and is met with in two forms in the inorganic group : (1) ordinary cis-trans, transformation ; (2) inversion in which there is a transference of radicals from inside the co-ordination to the outside and *vice versa*. The latter form of inversion is so characteristic of these compounds that Dr. Neogi proposes for it a new name—Werner Inversion—and has undertaken to deal with it in greater detail elsewhere.

It is not generally known that the trophy for the highest specific and molecular rotations lies with the inorganic compounds, the values for *l* dodecammino-hexol-tetracobaltic bromide being —4500° and —15,000° respectively. There are still many gaps in the study of optical isomerism in inorganic compounds and Professor Neogi invites the votaries of both the branches of chemistry to the task of completing the work which was started so ably by the immortal Alfred Werner.

B. S.

GEOLOGY :

PROF. N. P. GANDHI'S address deals with two topics of great interest to geologists as well as to workers in other branches of science. After indicating the aims and objects of pure geology, its cultural value is brought out with special reference to classical hypotheses like those of Hutton and Playfair. The 'contacts' of geology with other branches of science and the additions to knowledge accrued thereby are exemplified by the controversies regarding the age of the earth and the nature of its interior. The neglect of geology by Indian Universities is inexplicable particularly when considering that geologists can carry out very valuable work either in industrial concerns or in Universities. Effective remedies are suggested for securing due recognition to geology in University curricula.

The second part of the address deals with the organization of Mineral Research in India. Instances are cited of international movements of minerals and mineral products which have resulted in 'overdevelopments' of minerals and this is characterized as waste—'physical waste of raw materials and equipment, economic waste, employment waste and social waste'. To remedy the defects in the mining industry of India a five-year plan is suggested to deal with industrial mineral research by an organization similar to that prevailing in America. Attempts should also be made to educate the public by supplying suitable information on various aspects of Indian geology in popular language, well illustrated and distributing them at a nominal cost. The address concludes with a strong appeal to focus public attention on the important and urgent questions relating to the mining industry of India.

MATHEMATICS AND PHYSICS :

DR. A. L. NARAYAN'S address naturally concerns itself with recent developments in Spectroscopy, the subject to which Dr. Narayan and his co-workers have principally devoted themselves during the past several years. A wide range of topics has been surveyed, including vector coupling, vacuum spectroscopy, Hyperfine structure, Molecular structure and the Raman Effect. Application of Physics to the study of the heavenly bodies also comes in for particular mention ; the origin of the auroral green line and of some lines in the spectra of the corona and of the Nebulæ are discussed in this connection. The application of the Raman Effect to the verification of Boltzmann's law of distribution of the different states of energy of molecules and to an ocular demonstration of the dissociation of electrolytes is also dealt with.

Taking first the question of vector coupling in atomic spectra, the two extreme types, *viz.*, l-s and j-j coupling, are discussed, and the criteria available for distinguishing between these types, *viz.*, the positions of the energy levels, the intensities of the inter-combinations and the Zeeman Effect, are then detailed. It is recalled how in actual cases the coupling is mostly of an intermediate type so that a distinction according to one or the other of these extreme cases becomes well-nigh impossible. Expression is then given to the conviction that a study of some of the more complicated Spectra is bound to lead to further advances just as the study of simpler cases paved the way for some of the most important modern advances in Physics.

The next topic to be referred to is vacuum spectroscopy of the extreme ultra-violet and the importance of this to the study of the spectra of "stripped atoms" initiated by Millikan and Bowen. The method of using a grating at grazing