

the Deccan canal areas have therefore been surveyed as regards substrata and subsoil water levels and their connection with irrigation and percolation from channels.

Based on this, soils have been classified as regards permissible intensity of irrigation—with and without land drainage—and limits of cane irrigation have been fixed by catchments and sub-catchments.

Similarly fruit gardens have been restricted to areas where the most suitable soil-cum-drainage conditions will continue to prevail.

9. The block system, originated in 1906 by Sir M. Visvesvaraya, has been improved by unitisation and standardisation and is now enforced on all the Major Canals in the Deccan.

10. In Sind the Development and Research Division was opened in 1930. Under it complete subsoil surveys of the Lloyd Barrage areas have been made and maintained up to date; much

work has been done on models of various masonry works, resulting in standardisation of design: investigations into flumes, falls and flow in channels are in hand, and an important silt survey of the Indus, the Nara and the Jamrao Canal is also being carried out.

11. The formation of a Central Committee of Research, subsidiary to the Central Board of Irrigation, which was formed a few years ago, was a step of immense importance to the future of all-India Irrigation Research.

12. 25 Bombay Public Works Department Technical Papers dealing with the researches carried out in the Deccan and 10 dealing with those in Sind have been published and are obtainable from the Superintendent, Government Printing and Stationery, Bombay; through the High Commissioner for India, India House, Aldwych, London, W.C. 2; or through any recognised Book-seller.

## Research Notes.

### On a Theorem of Milloux.

DINGHAS (*Math. Zeit.*, 39, pp. 590–596) has succeeded in generalising a theorem due to Milloux about integral functions of infinite order, by means of which he proves some results about a class of integral functions of infinite order which are analogous to some theorems in the theory of integral functions of finite orders—e.g., Phragmen-Lindlöf theorem and Denjoy-Ahlfors theorem—on the maximum number of asymptotic values of an integral function of finite order. The theorem that he proves (analogous to Phragmen-Lindlöf theorem) at the outset is that if an integral function  $f(z)$  satisfies the conditions set forth below in the infinite strip defined by  $z = x + iy$ ,

$$x \geq 0, |y| \leq \frac{\pi}{2k},$$

$$\lim_{n \rightarrow \infty} e^{-\rho x} \log M_n(x) = 0,$$

$$[\rho > 0, \text{ and finite}]$$

$$\lim_{n \rightarrow \infty} e^{-\rho x} \log M(x) = \sigma \neq 0$$

$$\text{where } M_n(x) = \max |f(t \pm \frac{\pi i}{2k})| \text{ for } 0 < t \leq x,$$

$$\text{and } M(x) = \max |f(x + iy)| \text{ for } |y| \leq \frac{\pi}{2k},$$

$$\text{then } k \leq \rho.$$

The proof of this theorem depends on the following lemma. If  $g(z)$  is an integral function, satisfying the conditions

$$|g(x \pm i \frac{\pi}{2k})| \leq M_0, \quad |g(x + iy)| \leq M,$$

$$|g(iy)| \leq M_0 \text{ in } 0 \leq x \leq a, \quad |y| \leq \frac{\pi}{2k}$$

(It is supposed that  $M_0 < M$ )

$$\text{then } \log |g(z)| \leq \log M_0 + \frac{4}{\pi} \log \frac{M}{M_0} e^{k(x-a)}.$$

After the proof of this theorem he introduces the notions of order, type, etc., for a class of integral functions of infinite order. [The

order  $\rho$  is defined as  $\lim_{x \rightarrow \infty} \frac{\log \log M(x)}{x}$ , where

$M(x)$  is the maximum of  $|f(z)|$  for  $|y| \leq \frac{\pi}{2k}$ . With these definitions he proves the

following interesting result.—There does not exist any integral function of order  $\rho$  (in the new sense) in a strip of breadth less than

$\frac{\pi}{\rho}$  and which is of minimal type if it is of

the same order in any sub-region of the strip and which is of either the maximal or the normal type. After proving another lemma he deduces another interesting result in connection with this class of integral functions which is analogous to the Denjoy conjecture about the asymptotic values of an integral function of finite order which was proved by Ahlfors in 1930.

K. V. I.

### On the Prime-Numbers of Some Arithmetical Progressions.

ERDOS (*Math. Zeit.*, 39, pp. 473–491) develops a method for the proof of the

Bertrand-Postulate in the case of prime-numbers of an arithmetical progression  $a + nd$  [ $(a, d) = 1$ ]. On account of the generalised prime-number theorem the Bertrand-Postulate (that there exists prime-numbers out of  $a + nd$  between  $\xi$  and  $2\xi$ ) is true provided  $\xi$  is taken sufficiently large. [The limit depending on  $a$  &  $d$ .] Breusch had proved by considering the numerical positions of the first few zeros of the corresponding  $\zeta$ -function that Bertrand's Postulate is true in the case of the progressions  $3n \pm 1$ ,  $4n \pm 1$ , if  $\xi > 10^6$ , and by reference to a prime-number table he reduced the upper limit  $10^6$  to 7. The author's method is elementary and as such it is applicable in the case of only a few progressions. The method is analogous to the Tchebechef proof of the theorem that  $\pi(n) = O\left(\frac{n}{\log n}\right)$ . He introduces an integral expression

$$P_n(a, d) = \frac{\prod_{p|d} p^{\left[\frac{n}{p-1}\right]} \prod_{k=1}^n (a + kd)}{n!} \text{ and proves}$$

some results in connection with its order and its structure (*viz.*, divisibility by primes, etc.). It is interesting to note that this method also enables him to give *elementary* proof of Dirichlet's theorem about the occurrence of an infinite number of prime-numbers in an arithmetical progression in the case of arithmetical progressions for which

$$\sigma(d) = \sum_{\substack{p \times d \\ p < d}} \frac{1}{p} < 1. \text{ By means of a numerical table which he has constructed he deduces that in all cases where } d < 29 \text{ this method is applicable; but in the case of } d = 7, 11, 13, 25 \text{ and } 27, 2d \text{ is to be taken as the difference and in the case of } d = 17, 19, 23, 6d \text{ is to be taken as the difference.}$$

He also proves that if  $\sigma < \frac{d-2}{2(d-1)}$  then Bertrand's Postulate about the progression  $a + nd$  is true if  $\xi$  is chosen sufficiently large. This applies to progressions of the form  $6k \pm 1$ ,  $12k \pm 1$ , and  $12k \pm 5$ . ( $\therefore 4k \pm 1$ .) In the case of  $d = 6$ , the sharper result that there exists a prime-number of the progression between  $\xi$  and  $1.5 \xi$ , is true if  $\xi$  is chosen large enough. He next sharpens this result to the case when  $\sigma < \frac{1}{2} - \frac{d}{(d-1)(2d+1)}$

He also calculates the lower limits for  $\xi$  in the case of a few arithmetic progressions.

The lower limits obtained are far smaller than those obtained from the functions-theory method.

K. V. I.

### The Theory of Reduced Simple Continued Fractions (*Reduziert-Regelmässiges Ketten-Brüche.*)

ZURR. (*Math. Ann.*, 110 B, 5 Heft, pp. 679-717) has developed completely the properties of this type of continued fractions. Reduced simple continued fractions are continued fractions of the following form  $b_0 - \frac{1}{b_1 + \frac{1}{b_2 + \frac{1}{b_3 + \dots}}}$  where  $b_v$ 's are positive integers and  $b_v \geq 2$  for  $v \geq 1$ . The paper is divided into three chapters. The first chapter deals with the introduction to the theory and concerns itself with the simple properties of convergents  $\frac{A_v}{B_v}$ , and the development of any number as a continued fraction of this type. Here are some of the interesting results

- (1)  $\frac{A_v}{B_v}$  decreases monotonically,
- (2)  $\lim_{v \rightarrow \infty} [B_v - B_{v-1}] = \infty$ ,
- (3)  $\frac{B_{v+k-1} - B_{v+k-2}}{B_{v+k-2}} \geq \frac{1}{k}$ .

The second chapter is devoted to the study of the way of approach of the convergents towards the number which is developed as a continued fraction of this type. Conditions for a fraction to be a convergent of a reduced simple continued fraction development of an irrational number are given which are analogous to the conditions in the case of the ordinary continued fraction development. We come across certain interesting results in the third chapter. Here we find a detailed and systematic study of periodic continued fractions of this type. Results some of whom are analogous to the classical theorems of Lagrange and Galois in connection with ordinary periodic simple continued fractions are enunciated and proved. The paper also contains a table which gives us the development of  $\sqrt{D}$  [ $D = 2$  to  $99$ ] as a continued fraction of this type. These developments possess one advantage over the ordinary continued fraction development; for, we can solve the diophantine equation  $x^2 - Dy^2 = k$  by



means of the former for  $|k| \leq 2\sqrt{D}$  and whereas by means of the latter we can solve the equation only for  $k \leq \sqrt{D}$ .

K. V. I.

#### "Bleeding of Cements."

ORDINARY Portland Cement when used for making concrete blocks, has a tendency to separate itself from the excess water used in the mixture, which has been termed "bleeding". Very often, this leads to disastrous results in dams and retaining walls on account of the voids created by the free water which is subsequently removed by evaporation or otherwise. It is usually found that cements of abnormally low surface area exhibit an excessive tendency to bleed. One of the ways of getting over the trouble has been in using Portland Cement ground to a fine state of division. The latest development in this field has been, in grinding standard cement clinker to a superior degree of fineness in presence of a small amount of organic dispersing agents which consist of polymers of condensed naphthalene sulphonic acids. An exhaustive study has been made by L. S. Brown (*Ind. Eng. Chem.*, 1935, 27, 79) who has shown that the addition of such dispersing agents reduces the porosity of the gel; hence the loss of water and the formation of voids in the concrete is considerably diminished.

M. P. V.

#### The Vitreous State.

G. HÄGG (*J. Chem. Phys.*, 1935, 3, 42) correlates the tendency for the formation of amorphous melts with the existence of atom groups kept together with strong attractive forces. A melt having such structures so large or irregular as to render the addition to a crystal lattice difficult shows a large tendency for supercooling and glass formation. Metals and simple compounds, which show little tendency to formation of such large or irregular groupings, do not form vitreous solids. On the other hand, a large class of substances such as the oxides of certain metalloids (such as Si, B, Ge) and the corresponding acids and salts show this quality in a large measure. This behaviour is attributed to the tendency on the part of metalloid atoms to co-ordinate oxygen in a definite way, which brings about the formation of complex structures which retard

crystallisation. This hypothesis gives a rational interpretation of the diminished tendency to form glass-like melts in certain systems as the percentage of basic oxide is increased.

K. S. G. D.

#### Activation of Papain and Cathepsin.

RESULTS of a far-reaching character have been indicated by Purr (*Biochem. J.*, 1935, 29, 13) in the course of his extensive investigation on the relation between intracellular enzymes and vitamins. It was known, for some time past, that sulphydryl compounds are specific activators for proteinases. In 1933, Purr discovered that vitamin C-Fe<sup>++</sup> complex activated cathepsin and arginase and later Maschmann and Helmert (1934) showed that papain, a proteinase of vegetable origin, was activated by vitamin C in presence of bivalent iron salts, the vitamin C-Fe<sup>++</sup> resembling in this respect HCN. The investigations reported in this paper show that the activation brought about by different agencies are all of a similar character.

Both vitamin C-Fe<sup>++</sup> and pyruvic acid-Fe<sup>++</sup> activate papain only indirectly, as they are unable to activate purified, reversibly inactivated papain (prepared according to the method of Purr [*Biochem. J.*, 1935, 29, 5]). Unpurified commercial papain, on the other hand, is readily activated. From the observation on the effect of fixed SS proteins on the activation phenomena of papain, it can be concluded that unpurified commercial papain contains fixed SS-forms of protein which the vitamin C-Fe<sup>++</sup> complex in the presence of the papain complex converts into the SH-form. Neither the vitamin C-Fe<sup>++</sup> nor the papain can bring about the reduction individually. Similarly when oxidised glutathione and vitamin C-Fe<sup>++</sup> are added to inactive papain, the reduction of oxidised glutathione (or oxidised papain?) is brought about. The activation of papain by vitamin C-Fe<sup>++</sup> apparently depends on the presence of SS-groups either in the glutathione molecule or in the fixed SS-protein. The real activators of papain are the sulphydryl compounds and the observed activation by HCN, and by vitamin C, pyruvic acid and succinic acid in the presence of bivalent iron, is an indirect effect.

The activation phenomena of cathepsin are essentially similar to those of papain. The author concludes that papain and cathepsin in the active state are fixed



SH-proteins of definite constitution, while the reversible inactivation forms of these enzymes appear to be SS-forms.

B. N. S.

### Occurrence and Distribution of Diatoms in the Punjab.

*The Journal of the Asiatic Society of Bengal* (1934, 29, 307-309) contains "A Short Note on the Occurrence and Distribution of Diatoms in the Punjab" by M. Abdul Majeed. The author has pointed out that the bare wet garden lawns generally harbour a few species of *Naricula* and *Nitzschia*. The ponds, pools and tanks are the most productive places and the epiphytic Diatoms form an interesting part of the study of the algal-flora of the Punjab. Species of *Surirella* which are common in other districts have not been found in Lahore, whereas species of *Rhopalodia* and *Epithemia* seem to be restricted to Lahore and its outskirts. According to the author species of *Asterionella* and *Tabellaria* so prevalent in Europe seem to be absent in the Punjab.

### Germ Layers of Certain Diprotodont Marsupials.

T. KERR has described some early blastocysts of certain Diprotodont Marsupials (*Quar. J. Micro. Sci.*, 1934, 77, Pt. II, No. 306) and has studied the formation of the germ layers. An almost complete series of blastocysts from the unilaminar stage to that showing the appearance of the first rudiments of mesoderm has enabled the author to describe the origin of the endoderm and mesoderm. The former arises as a number of isolated mother cells which migrate inwards and forms a continuous layer, similar to that described by Hill in *Dasyurus*. Large included cells from which Hartmann derives the endoderm in *Didelphys* are rare and when they are present, show obvious traces of degeneration. The mesoderm arises as an active proliferation of cells of the ectoderm in the formative area. At first continuous with the ectoderm, this heap of cells later separates and forms a distinct layer.

### The Zoological Relationship of the Conodonts.

FROM a long time there has been a keen controversy regarding the exact zoological affinity of the conodonts. The vertebrate

palaeontologists seldom claim them as remains of vertebrates, and the invertebrate palaeontologists hesitate to classify them among the invertebrates. Thus there has been a tendency for each group of workers to force the ownership upon the other group. Indeed this group of animals seems to be mysterious since their remains have been classified in such diverse groups as Pisces, Annelids, Mollusca, Crustacea, etc. But for a long time, however, they have been regarded as the remains of a certain group of fishes. In a recent communication to the *Journal of Palaeontology* (Vol. 8, No. 4), H. W. Scott has made a detailed study of the conodonts from the shales of the Quadrant formation. From the characters he has deduced that the conodonts have a greater affinity to the group of Vermes rather than to fishes.

### Sedimentation and Stratigraphy from Modern Points of View.

W. H. TWENHOFER, the author of the well-known work *Treatise on Sedimentation*, has rendered a distinct service for geologists and sedimentary petrologists in particular, by reviewing the development of the study of sedimentation and stratigraphy from the earliest times, in his lecture before the Society of Economic Geologists and Mineralogists (*Journal of Pal.*, 8, No. 4). The findings of most of the geologists like Wrener and Cuvier have been challenged since they were based on incomplete observations and in certain cases on lack of knowledge. Of late the detailed study of sediments especially by Barrell, Milner and Boswell has shown that sedimentation is a complex process and that all like sediments need not have the same history. The process itself depends upon a number of variable factors and the sediments should therefore be studied as products of environmental conditions. In the words of the author "the sediments are not dead substances, but fragments of ancient history of which the reading is destined to make necessary the rewriting of much geologic history and the redrawing of much ancient geography". The common tendency to make generalisations regarding the origin of similar sediments must be avoided. Each must be studied independently and therein lies the key to the palaeogeographical conditions of the past.



### The Skull of Holocephali.

OUR knowledge about the fish skull is far from being complete and recently a comprehensive account of the Teleostean skulls was published by William K. Gregory. The primitive groups like Holocephali have received very little attention and the paper by G. R. de Beer and J. A. Moy Thomas in the *Phil. Trans.*, 1935 B., 514, is certainly welcome. The former author by a careful study of the available embryological material of Holocephali elucidates the real nature of the palatoquadrate attachment, the structure of the hyoid arch and the nature of the so-called ethmoidal canal. The pterygoquadrate

is fused to the neuro cranium and an otic process is present. The skeleton of the hyoid arch is primitive and possesses pharyngo-hyal and epiphyal; it is non-suspensorial. The presence of the pharyngo-hyal points definitely to the conclusion that the ancestors were never amphistylie or hyostylie. The group Holocephali must have taken its origin from autodiastylie ancestor, from which also the selachian must have radiated. Thus the selachians are closely related to Holocephali. The third point which is stressed in the paper is about the ethmoidal canal; this canal is an extra-cranial space secondarily roofed over when the interorbital septum is formed.

### Science Notes.

*An Interesting Implement for Mud-fishing from Uttarbhag, Lower Bengal.*—At a meeting of the Asiatic Society of Bengal held on 4th March, Dr. S. L. Hora gave an account of a device for securing *Jiol Machh* from marshy areas in Lower Bengal. "A circular basket of the usual material and make, about 9½ inches in diameter and 23 inches in total length, is used. One end of the basket is open and the mouth is strengthened by a circular band of broad bamboo-strips. At a distance of about 16 inches from the mouth, there is another band of bamboo-strips, after which the split-bamboo sticks are pulled together and secured by a loop of string. The loop is fastened to the nearest band. In this way, the other end of the basket is closed and made to serve as a handle for manipulating the basket.

"The split-bamboo sticks, which run lengthwise, are about half an inch apart so that when the open end is dragged through mud, it passed out through the wide spaces and only the fish are trapped inside the basket."

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*A Note on the Distribution of Gloriosa superba Linn. (Vern.:—Bechnag, Kulhari, Bisha, etc.) towards Vikarabad and its medicinal importance.*—Messrs. M. Sayeeduddin and M. Abdus Salam, write: "We pointed out in our previous communication to *Current Science*, Vol. II, No. 3, Sept. 1933, p. 83, that, while ascertaining the distribution of *Lantana camara* Linn. towards Vikarabad we met with at a spot about 24 miles from the Hyderabad city a striking association of *Lantana*, *Gymnosporia montana*, *Butea frondosa*, *Tectona grandis*, *Dodonaea viscosa* and *Gloriosa superba* of which the last named was found evidently for the first time in our excursions towards this side. There is no definite record of its having been found this side before. The only reliable information one can get of the Hyderabad vegetation is from two works namely *Forest Flora of Hyderabad*, Decun by E. A. Partridge (Pub. 1911) and from *The Madras Journal*, Vol. XV (Pub. 1848) in which there are abstracts of botanical reports about Warangal and Dawlatabad districts. Partridge writes (p. 402) that "*Gloriosa superba* is very common everywhere, springing up after the rains in field-hedges and on the outskirts

of forests." Later on he mentions "Common in hedges, chiefly on black cotton soil." The latter statement makes us believe that his observations were made chiefly towards the Marhatwari side where the soil is mostly black and very suitable for the growth of cotton. No mention is made about this plant in the *Madras Journal* either, in which besides others, many plants of medicinal importance have been recorded. *Gloriosa superba* too happens to possess a few valuable medicinal properties (ref. Kirtikar, *Ind. Med. Plts.*, and Watt, *Dict. Econ. Prod. I.*) and it is strange that this plant has escaped the notice and consideration of the author of the above botanical reports.

It was summer time when we last visited Vikarabad. But in order to make a preliminary survey of its vegetation during the rainy season we undertook an excursion recently in August 1934. What was most striking is the gradual spread of *Gloriosa superba* and its association with *Gymnosporia montana* (Family Celastraceæ) whose root-action is claimed by Mr. Abdur Rahman Khan (ref. *Osmania University Research Jour.*, 1934), to be one of those responsible for turning rocks into morum. In all the cases mentioned below *Gloriosa superba* was found chiefly on *Gymnosporia montana*, which seems to prefer rather dry situations and hard substratum. While *Gloriosa superba* does not seem to be restricted to any particular kind of soil, it seems to have its own associations.

The exact spots where this plant was found within a distance of about 52 miles from the Hyderabad city are the following:—

16 miles and 7 furlongs from the city—A single plant on *Gymnosporia montana*. Between 16 and 18 miles—At two spots again in the same association. Between 18 and 19 miles—At several places with *Gymnosporia*, profusely in flower. Between 20 and 21 miles—All cultivated land, in some places slightly hilly. No trace of *Gloriosa*. At 21 miles.—*Gloriosa superba* amongst dense vegetation consisting of *Gymnosporia*, *Dodonaea viscosa*, *Zizyphus* sp., and several herbs. Between 21 and 44 miles—No trace of *Gloriosa*. After this nearing Vikarabad it was noticed at one spot only. But it was to be found again in