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THE OPTIMUM SIZE OF RESEARCH GROUPS FOR MAXIMUM EFFECTIVENESS

Part II.—A Theoretical Model, and its Correlation with the Two Basic Empirical Distributions

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(Received June 1, 1969)

In part I of this paper, a statistical analysis of the sizes of various scientific research organizations was shown to yield two basic distributions for density of scientific effort versus their size, expressed as the number, N , of scientific officers in a research unit. In order to analyze the factors underlying these two distinct distributions, a theoretical model is here set up to represent the output of a research unit, consisting of N scientific officers, as a function of their mutual interactions. These interactions are represented by (i) an interaction parameter, m , (ii) a wasteful-effort parameter, α , and (iii) a critical size parameter, N_0 , and the following equation is obtained:

$$\text{Per capita output} \propto 2 \left(\frac{N}{N_0} \right)^m / \left\{ 1 + \left(\frac{N}{N_0} \right)^{m+\alpha} \right\},$$

with $0 < m \leq 1$ and $1 < \alpha < 2$. Using the postulate that density of scientific effort \propto (per capita output) ^{n} , this gives

$$\text{Density of scientific effort} \propto \left[2 \left(\frac{N}{N_0} \right)^m / \left\{ 1 + \left(\frac{N}{N_0} \right)^{m+\alpha} \right\} \right]^n,$$

which can be solved to fit the empirically derived distributions when $1.8 - m \leq \alpha \leq 1.9$. Taking α in the middle of this range, i.e. $\alpha = 1.83 - \frac{1}{2}m$, we obtain $n \simeq 5\frac{1}{2}$ and $N_0 = 98 \pm 10$, with $m = 0.20 \pm 0.05$ for one distribution and $m = 0.6 \pm 0.1$ for the second distribution.

The nearly constant value of N_0 shows that the theoretical model is a good approximation, and the two values obtained for m , viz. 0.2 and 0.6, indicate that the interdependence between workers is relatively small in case of agriculture research, as against the high value for industrial research. A similarly high value of m (~ 0.7) is obtained for defence research in the U.K., which again yields $N_0 \simeq 100$. The common value of 98 ± 10 for N_0 provides us with a quantitative formulation of the Parkinsonian decrease of efficiency, viz.

$$1 / \left\{ 1 + (N/N_0)^{m+\alpha} \right\} = 1 / \left\{ 1 + (N/98)^{1.83 + m/2} \right\}$$

and it is hoped to study the application of the corresponding output formula to various organizations in a later paper.

INVESTIGATION OF THE CHARACTER OF THE JUMPS IN ACTIVATION ENERGY OF VISCOUS FLOW IN PURE LIQUIDS AND SOLUTIONS

Part III.—Experimental Differentiation of the Jumps Induced by Boundary-Layer Effects

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(Received July 16, 1969)

In view of the conflicting opinions regarding the nature and interpretation of the discontinuous jumps observed in the flow activation energy of water, a critical synoptic analysis is made of the refractometric measurements and dilute aqueous ethanol solution and pure water taken at grazing and nongrazing incidence. This leads to the result that only 35% of all the observed minima in (dn/dT) can correspond to genuine bulk anomalies, while the rest are induced or augmented by the glass-liquid interfacial boundary of 0 to 1 mm thickness.

This interpretation is confirmed by some preliminary measurements taken with (i) a different viscometer in a different laboratory, and (ii) a viscometer having a wider capillary. The boundary-induced anomalies are found to be very sensitive to changes in the viscometer, and to (gradually) disappear with increasing diameter. It is shown that in the range of 20°C to 50°C, only the activation jumps at 22°C, 27°C, and 42°C can be considered as authentic anomalies in the bulk properties of water.

THE INFRARED SPECTRA OF ALKYLTRI-*p*-TOLYL ARSONIUM COMPOUNDS

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(Received December 13, 1968)

The IR spectra of *p*-tolyl arsonium compounds have been recorded and assignments of the bands in 1600-700 cm^{-1} region have been made. The intensity of the 1600 cm^{-1} and 1490 cm^{-1} bands are found to depend on lone pair interaction since the former is weak and the latter is strong in tri-*p*-tolyl arsine while it is the reverse in the *p*-tolyl arsonium compounds. The splittings in the 800 cm^{-1} band are noted in the arsonium compounds and this together with the higher intensity of the 1410 cm^{-1} band is suggested to imply an unsymmetrical orientation of the rings.

SPECTROSCOPIC STUDIES OF ORGANOPHOSPHORUS COMPOUNDS**Part V.—Ultraviolet Spectra of Phosphine-*p*-Benzoquinone Adducts**

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(Received February 17, 1969)

The UV spectra of phosphine-*p*-benzoquinone adducts have been studied under acid and basic conditions. The position of the bands is susceptible to changes in pH. In the acid medium there is a decrease in intensity of the $n \rightarrow \pi$ transition, as in ionized carboxyls while in the basic medium, there is a red shift with an enhancement in intensity, which is characteristic of phenols. In the phosphonium dithioformates also similar variations are noted. These observations suggest that the betaine structure is favoured in the acid medium while the phosphinemethylene structure is dominant in the basic medium.

THIOPHOSPHORYL ADDUCTS OF NITROGEN BASES

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(Received March 10, 1969)

Thiophosphoryl and phenylthiophosphoryl chloride have been shown to form adducts with ethylenediamine and dipyridyl in variable ratios. Similar adducts of pyridine could not be purified. The stoichiometry seems to depend on the number of chlorines attached to phosphorus. In the case of dipyridyl complexes, thiophosphoryl chloride forms the adducts in the ratio 2:5 while phenylthiophosphoryl chloride forms a 1:1 adduct. With ethylenediamine, on the other hand, the ratio with thiophosphoryl chloride is 4:15 and with phenylthiophosphoryl chloride it is 2:5. The adducts have been formulated as ionic substances.

STUDIES ON COORDINATION OF COMPOUNDS**Part I.—Nickel(II) Complexes of Adipyl Dihydrazide**

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Adipyl dihydrazide complexes of the type $[\{ \text{Ni} (\text{Adipyl dihydrazide}) \cdot 2\text{H}_2\text{O} \} \text{X}_2]_n$ where X is chloride, bromide nitrate or sulfate are reported. Their insolubility in all organic solvents suggests a polymeric nature. Models for the compounds do not support a chelated metal ion. The magnetic data and visible spectra suggest an octahedral structure with tetragonal distortions. The conductivity shows that the anions are outside the coordination sphere. The high value for the ligand field parameter as also the IR spectra indicate that the terminal amino groups are donors and hence form a linear polymer.

TRANSITION METAL COMPLEXES OF 2-GUANIDINOBENZIMIDAZOLE

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(Received September 10, 1968; revised April 8, 1969)

Metal complexes of the type $[M(\text{GBM})_2\text{X}_2]$ and $[M(\text{GBM})_3] \text{X}_{2-3} \cdot \gamma\text{H}_2\text{O}$, where $M = \text{Fe(III)}$ and Co(II) , $\text{X} =$ anions such as chloride, nitrate, acetate, perchlorate and sulphate, $\text{GBM} = 2$ -guanidinobenzimidazole (I), have been prepared from nonaqueous solvents. These complexes are found high spin with magnetic moments in the range 5.8-5.85 B.M. (for Fe(III) complexes) and 4.45-5.12 B.M. (for Co(II) complexes). The electronic spectra of Co(II) complexes show bands at 18,380-20,000 cm^{-1} (d-d transition bands) and 32,900-34,120 cm^{-1} (charge transfer bands). IR spectra made it possible to assign the metal-nitrogen bond sites.

THE TEMPERATURE DEPENDENCE OF INTERMOLECULAR ACTIVATION ENERGY FOR FLOW IN LIQUID AND SOLUTIONS

Part VIII.—Influence of Sodium Chloride Concentration on the Activation Energy Jumps Observed in Water

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(Received June 10, 1969)

Accurate measurements of flow activation energy of aqueous sodium chloride solutions (0 to 2% by weight) at close intervals of concentration (in the temperature range of 10° to 50°C) have been undertaken and reported in this communication. On examining the results for the temperature of the jumps observed in $10^{-3}E_{\eta}/R$, and the "supercooling" effect persisting in these NaCl solutions, one may infer that cooperative structural breaking up and reforming occurs within the various sodium chloride solutions, but certain concentrations of NaCl strongly modify the water structure persisting in all these solutions. This may lead to appearance, disappearance, and coalescence of certain steps (as experimentally observed in these solutions) with change in magnitude of the jumps, through either volume or surface-induced ordering in a thin layer.

PREDICTION OF A CHEMICAL REACTION IN A GAS-FLUIDISED BED

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(Received December 16, 1968)

Following some recent investigations of the phenomenon of cloud formation around bubbles in aggregatively fluidised beds, mathematical models have been developed to predict the performance of a fluidised-bed reactor for the two ideal conditions of a perfectly mixed dense phase and plug flow of gas through the dense phase. The theoretical predictions of reactor performance have been compared with the experimental results of a first-order catalytic gas phase reaction, carried out in an 18-inch diameter fluidised-bed reactor in which the size of the catalyst particles, the gas flow rates, the bed height and the reaction rate were widely varied.

**PROFILE DISTRIBUTION OF DIFFERENT FORMS OF IRON OXIDES
IN SOME EAST PAKISTAN SOILS**

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(Received February 4, 1969)

The distribution of different iron oxides in soils has been studied with reference to their location in the landscape. The highland and the lowland soils showed different distributional trends of iron oxides within their profiles which indicated that different soil-forming processes were in operation.

BIOSYNTHESIS OF AMINO ACIDS FROM HYDROCARBONS

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(Received October 15, 1968; revised February 15, 1969)

The growth of A-18 (*Bacillus subtilis*), a hydrocarbon utiliser, was studied after supplying different sources of carbon and nitrogen. Kerosene sample supplied by National Oil Refinery (N.O.R.) proved to be the best source of carbon when ammonium nitrate or urea was used as a source of nitrogen. Bacterial growth was maximum when 4% concentration of kerosene (N.O.R.) was used. The growth, however, decreased when kerosene was replaced by other sources of carbon and was minimum in case of n-decane. Natural gas or naphtha did not support the growth. The strain produced the following amino acids: asparagine, serine, glycine, lysine, glutamic acid, threonine, alanine, histidine, arginine, tyrosine, proline, valine, phenyl alanine, isoleucine and leucine.

THE EFFECT OF DIETARY CHANGES ON THE FATTY ACID COMPOSITION OF GOAT'S MILK

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(Received March 12, 1969; revised April 5, 1969)

Eighteen samples of fresh raw goat's milk were analysed for their lipid composition. The goats were kept on a fat-free basal, butterfat or corn oil diet for a period of 4 weeks. The milk fat contained 82-92% triglycerides, 1.8-2.5% cholesterol and 0.2-0.7% phospholipids for the various diets. Of the total milk fat, 88-96% was in the fat globule. No significant change was observed in the amount of total fat of milk when one diet was replaced by another. However, the value for total cholesterol was found to be significantly higher when a butterfat diet as compared with a diet contained corn oil was fed. On various diets, the saturated fatty acids of the fat globule consisted primarily of arachidic (1.0-2.5%), stearic (14.9-15.0%), palmitic (19.9-34.8%), myristic (6.1-8.1%), lauric (2.5-3.4%), capric (4.2-8.1%) and caprylic (2.4-2.8%). Among the unsaturated acids, oleic (18.4-30.0%), linoleic (2.7-3.0%) and linolenic (1.3-1.5%) were most common. Traces of other monoenoic acids were also encountered. Alterations in the proportion of linoleic acid was noted when butterfat was replaced by the corn oil diet.

SOME PHARMACOLOGICAL ACTIONS OF CHAKSINE CHLORIDE

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P. C. S. I. R. Laboratories, Peshawar

(Received December 5, 1968; revised January 24, 1969)

Some pharmacological actions of chaksine chloride have been studied. Chaksine chloride in 0.5, 1.0 and 2.0 mg/kg-doses produced decrease in the height of muscle twitches of the indirectly stimulated tibialis anterior muscle in rabbits anaesthetized with urethane. The myoneural blocking effect was not seen in cats anaesthetized with nembutal sodium. The perfusate collected after the injection of 0.5 mg chaksine chloride into the rat hindquarter preparation produced a well marked contraction of the isolated guinea pig ileum which was specifically antagonized by mepyramine maleate, indicating that chaksine chloride releases histamine from the tissues.

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PHARMACOLOGICAL STUDIES OF PLUMERIA ACUTIFOLIA

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(Received May 16, 1969, revised August 9, 1969)

The aqueous portion of the alcoholic extracts of plumeria acutifolia, is a strong relaxant of smooth muscles of the intestine. Its action on isolated atria and heart are like those of acetylcholine. Its action on rat uterus are interesting in the way that it relaxes the uterine muscle and antagonises the action of syntocinon and oxytocin. The drug is not toxic and can be given in high doses.

INFLUENCE OF SOME NUTRIENT MEDIA ON THE TOXICITY OF ZERLATE TO HELMINTHOSPORIUM HAWAIIENSE

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(Received March 3, 1969; revised March 27, 1969)

The influence of corn meal dextrose agar, corn meal agar, oat meal agar, lima bean agar and sabouraud dextrose agar on the toxicity of zerlate to *Helminthosporium hawaiiense* (Bugnicourt) was determined.

It was observed that while 100% inhibition of *H. hawaiiense* was obtained when 0.033% zerlate was mixed in corn meal dextrose agar and corn meal agar media, little inhibition of the fungus took place at the same zerlate concentration on sabouraud dextrose agar. Oat meal agar and lima bean agar media also exert some influence and decrease the toxicity of zerlate but not as much as sabouraud dextrose agar medium. It may be presumed that there may be some kind of interaction between the medium and the fungicide which either decreases or enhances the toxicity of the test substance. It is, therefore, suggested that the medium factor may always be taken into consideration in testing the toxicity of fungicides.

REPORT ON ADDITIONS TO THE PENICILLIUM SPECIES FROM WEST PAKISTAN KARACHI

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(Received June 12, 1968; revised February 17, 1969)

A study of *Penicillium* species from Karachi was taken up. Malt extract agar and Czapek-Dox agar media were utilised for screening these fungi. A total of 15 species, namely: *Penicillium chrysogenum* Thom., *penicillium* near *P. chrysogenum*, *penicillium* near *P. corylophilum* Dierckx, *P. cyclopium* Westling, *P. expansum* Link, *P. Janthinellum* Biourge, *P. lilacinum* Thom., *P. martensii* Biourge, *P. notatum* Westling, *P. oxalicum* Currie and Thom., *penicillium* near *P. patulum* Bainier, *P. purpurogenum* Stoll, *P. rubrum* Stoll, *P. steckii* Zaleski, and *P. variabile* Sopp, were recorded. Out of these, *penicillium* near *P. chrysogenum* Thom., *penicillium* near *P. corylophilum*, *P. cyclopium* Westling, *P. martensii* Biourge, *penicillium* near *P. patulum* Bainier and *P. steckii* Zaleski have been reported from Karachi for the first time. The species which have never been recorded as such from West Pakistan include *penicillium* near *P. chrysogenum*, *penicillium* near *P. corylophilum*, *P. cyclopium*, *P. martensii*, and *penicillium* near *P. patulum*. Brief descriptions based on our specimens for these five species have been provided.

DORMANCY AND HARDSEEDEDNESS IN ABRUS PRECATORIUS LINN

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(Received January 3, 1969; revised April 9, 1969)

Three lots of *hard seeds* of *Abrus precatorius* Linn were collected in September and December, 1965, and March, 1966, and allowed to germinate on wet blotters in open petridishes at room temperature. The softening of seeds in the 3 lots showed a similar pattern over a period of 2½ years. In 1966, softening started in June and continued upto October; in 1967 large number of seeds softened in May while a total of only 7 seeds softened in 1968. This variation in softening of seeds has been attributed to changes in atmospheric temperature. Effect of sulphuric acid and temperature on the softening of *hard seed* fraction of *Abrus precatorius* has also been studied.

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THE STAGES OF THE MALE LAC INSECT

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P.C.S.I.R. Laboratories, Karachi 32

(Received November 26, 1968)

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THE GROWTH OF LARGE SINGLE CRYSTALS OF IRON

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(Received January 21, 1961; revised March 8, 1969)

Due to the increasing importance and demand as compared to the availability and cost of the large single crystals of metals and their oxides for the studies of metallurgy, corrosion, electronics etc. and their application in various new devices, the techniques of the large single crystal production have become of significant commercial importance. In this work the technique for the growth of large single crystals of 'Ferrovac E' and carburized zone-refined iron is described. The method was not successful in growing single crystals from zone-refined iron or nitrided zone-refined iron. Attempts to grow single crystals from 'Ferrovac E' were 90% successful.

STUDIES ON CARBOXYMETHYLCELLULOSE

Part VI.—Preparation and Properties of Potassium Carboxymethylcellulose

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(Received April 11, 1969)

It was confirmed that K-carboxymethylcellulose cannot be prepared directly from K-cellulose and monochloroacetic acid in aqueous medium. But it could be successfully prepared in aqueous-ethanolic medium according to new method developed in this laboratory.

Process variables and the effect on D.S. were studied. The reaction was found to depend on factors more or less similar to that found for Na-carboxymethylcellulose except that the best D.S. (1.19) was obtained in absolute alcohol medium. The D.S. could be increased with repetitive carboxymethylation and in four stages a value of 2.11 was obtained (compared to 2.63 reported earlier⁹ for Na-carboxymethylcellulose).

Results are presented on physical properties, detergency improving properties and emulsifying ability. K-carboxymethylcellulose was considered better than Na-carboxymethylcellulose for the preparation of cod-liver oil-water emulsion.

DEVELOPMENT OF LONG-LIFE ROTI (BREAD)

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(Received October 17, 1968; revised April 1, 1969)

A prototype roti which remained quite palatable for 72 hr at 35°C was developed. As expected glyceryl monostearate was found to make the roti soft but on the other hand it adversely affected the pliability of the rotis. The effect of addition of glyceryl monostearate on physical dough characteristics was also studied. To counteract this effect wet wheat gluten and freeze-dried wheat gluten were incorporated. Both forms of gluten increased the resistance of the dough on Brabender Extensograph to a peak value of 1000 mm. Rotis prepared with increased amount of gluten remained very soft and resilient up to 72 hr. Sorbic acid was not found a suitable mycostatic agent for use in rotis as it imparted a bitter after taste.

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EXTRACTION OF LEAD METAL FROM INDIGENOUS GALENA

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(Received September 19, 1968; revised January 14, 1969)

Extraction of lead metal from indigenous lead ore (galena) has been successfully carried out by smelting (precipitation) method. Effect of different fluxing agents on the distribution of lead metal in the slag-matte-system was studied by analysing the slag and matte for their diffused lead content while lead for its iron contamination. The appropriate amount of different components of the charge containing 1 kg of the ore (65% PbS) are found to be 50-75 g common salt, 100-110 g soda ash and 160-165 g iron scrap, smelting temperature ranging from 900°C-1000°C with a time period of 1½ to 2 hr. Optimum recovery of the metal ranged from 95-98% with a purity of 98.5 to 99.12% Pb, the impurity being mainly iron.

The availability of lead ore, iron scrap, various fluxing agents employed and the specific properties of the end-product ensure the feasibility of the process.

SCIENTIFIC GRADING OF JUTE

Part I.—Lustre Determination of Different Grades of Jute Fibre

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Technological Research Board, Jute Research Institute, Dacca 15

(Received February 3, 1969)

Decreasing value in the lustre has been observed in both Tossa and White jute from the higher grades to the lower grades. It may be possible to accept this as one of the indices in grading.

SCIENTIFIC GRADING OF JUTE

Part II.—Determination of Cellulose in Different Grades of Jute Using the Methods of Cross and Bevan*

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Technological Research Board, Pakistan Central Jute Committee, Dacca

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The cellulose content (determined by Cross and Bevan methods) of different grades of white (*Corchorous capsularis*) and tossa (*Corchorous olitorious*) jute has been found to decrease from the higher to the lower grades of jute. The data presented indicates that cellulose content of the various grades of jute may be used as an index for grading of jute.

Pakistan J. Sci. Ind. Res., 12, 421-432 (1970)

STUDIES IN YIELD OF SEED COTTON AND ITS RELATION TO LEAF NUMBER IN HIGH GRADE COTTONS

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Regular studies in yield of seed cotton and its relationship with leaf number in high grade cottons were conducted at Lyallpur during the years 1962-63 and 1963-64. Selection for low leaf number was found to be well combined with high yield of seed cotton, as 40 families in the first year and 24 families in the second year surpassed L.S.S. the commercial variety of Lyallpur zone in this respect, the actual range being 76.4-127.1 g in 1962-63 and 82.9-129.5 in the second year as compared to 74.5 and 81.3 g for L.S.S. during the 2 years. Fourteen families in the first year and 21 families in the second year possessed the least foliage and high yield and showed clear indications of success in developing high grade cottons.

STUDIES IN BRACTS, BURS, LINT COLOUR AND FOREIGN MATTER IN SOME PAK COTTONS

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Regular studies in bracts, burs, dirt, colour and foreign matter in high grade cottons were undertaken at Lyallpur during the years 1962-63 and 1963-64. The size of burs and bracts was found to be large in general. The percentage of shedding of burs was 0.0 to 3.5 in the first year and 0.0 to 3.7 percent in the second year. Shedding of bracts ranged from 8.5 to 35.7 percent in 1962-63 and 9.5 to 31.6 percent in 1963-64. The lint colour was found to be white in most of the cases, although slight variations existed due to varietal and environmental effects. The results indicated scope for improvement of colour grades by selection. The foreign matter content during both the years showed scope for reduction through selection, the actual range being 0.68 to 6.1 grams per plant as compared to 3.4 and 5.7 grams for L.S.S. during the first and second year respectively. The present programme of developing high grade cottons will, therefore, result in small bracts, high shedding of foliage at first pick and low foreign matter content.

STUDIES IN MERCERIZATION OF JUTE, COTTON AND SOME OTHER VEGETABLE FIBRES UNDER DIFFERENT TREATMENTS

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Studies in mercerization of jute, cotton and other vegetable fibres were conducted at Lyallpur during the two years 1965-66 and 1966-67 and the range of values was found to be 4.173-19.750%. The highest value was recorded by kenaf₂ followed by kenaf₁, patwa, jute, sunhemp, ramie flax, bombax cotton and calotropis, whereas the lowest value was observed in case of L.S.S., followed by other cotton varieties AC307, AC134 and 4F. The varietal differences were highly significant at all the stages of maturity and spacing effects were significant at seed maturity stage only and non-significant at pre-flowering and flowering stages. The manurial effects were found to be significant at preflowering stage and highly significant at flowering and seed maturity stages during both the years. There was a general fall in values of mercerization percentage from preflowering stage to seed maturity stage in all types of vegetable fibres during both the years. Preflowering stage of the plant is therefore the best for obtaining high quality fibres and desirable effects.

STUDIES IN NITRATION OF JUTE, FLAX, COTTON AND OTHER VEGETABLE FIBRES UNDER DIFFERENT TREATMENTS

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Studies in nitration of jute, flax, cotton and other vegetable fibres were conducted at Lyallpur during the two years 1965-66 and 1966-67 and values were found to range from 110.880 to 140.270%. The highest value was recorded by sunhemp, followed by calotropis, jute₁, jute₂, kenaf₂, kenaf₁, bombax cotton, patwa, AC134 and L.S.S., where the lowest value was observed in case of flax followed by ramie, AC307 and 4F. The varietal differences whereas found to be highly significant at all the stages of maturity. The spacing effects were significant at flowering and seed maturity stages and non-significant at pre-flowering stage. The manurial effects were highly significant at flowering, significant at seed maturity and non-significant at pre-flowering stage. A general decrease in the values of nitration percentage was observed in all vegetable fibres from the pre-flowering to the seed maturity stage and therefore, superior quality fibres for industrial purposes can only be obtained at the pre-flowering stage.

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STUDIES ON MOTHPROOFING OF WOOL

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Loose wool samples were treated with a range of concentrations of Dieldrin, Aldrin, Toxaphene and a newly developed insecticide of the chlorinated hydrocarbon type, Petkolin A. The resistance of these samples against the insect *Anthrenus vorax* was estimated in terms of feeding damage and mortality. The fastness of the treatments to the various conditions of use, washing, dry-cleaning, sunlight and daylight was also evaluated.

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FRictional PROPERTIES OF SOME PAKISTANI WOOLS

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The frictional properties of a few Pakistani wools have been measured by Lipson's method. The fibres have been classified into medullated, heterotypical and true types where applicable, and coefficients of friction, directional frictional effect and scaliness have been calculated for each type. A statistical analysis of the results together with their significance has been presented.

CERAMIC PROPERTIES OF SWAT CLAY

Part I.—Physical Characteristics

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Glass and Ceramics Division, P.C.S.I.R. Laboratories, Lahore 16

(Received November 11, 1967; revised November 13, 1968)

A comparative study has been made of the physical characteristics of the china clay of Swat State with those of an imported china clay. The results indicate that the indigenous clay is quite suitable as a ceramic material after simple water-washing and can successfully replace the imported china clay in pottery and porcelain manufacture.

CERAMIC PROPERTIES OF SWAT CLAY

Part II.—Chemical Characteristics

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(Received February 10, 1968; revised November 13, 1969)

Chemical characteristics of Swat clay were studied by determining its water soluble content, pH value and cation exchange capacity. For comparison, the characteristics of an English china PCI clay were also studied. Results indicate that the Swat clay has a high initial pH and a high exchange capacity than the imported china clay. Further the exchange capacity of the finer fraction of Swat clay was higher than the coarser fractions, suggesting that the ion exchange in Swat clay is partly a surface phenomenon. The high exchange capacity of Swat clay is believed to be due to the poor crystallinity of the clay crystals and the presence of such impurities as halloysite and montmorillonite.

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A STUDY OF GLASS SANDS FROM PIPRI AND FENI AREAS

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(Received October 1, 1968)

A laboratory investigation of beneficiation of two known deposits of glass sand in the Pipri and Feni areas of West & East Pakistan respectively have shown the deposits to be of rather uniform character. The sands were sieved and subjected to water washing to remove the clay stains followed by magnetic separation to eliminate biotite and other magnetic minerals and finally submitted to the Froth flotation and the other chemical treatments in order to remove all the iron bearing minerals. These treatments after Froth flotation gave a product containing 0.065% and 0.037% Fe_2O_3 for sands from Pipri and Feni areas respectively, whereas in the raw sands it was 0.37% and 0.30% respectively.

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**MINERALOGY OF CLAY DEPOSITS NEAR BAGH ($33^{\circ} 45' 30''$, $72^{\circ} 11' 40''$)
CAMPBELLPORE DISTRICT, RAWALPINDI DIVISION**

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X-ray, DTA, thermobalance and chemical analyses data have shown that Bagh clays are composed of kaolinite with subordinate amounts of diaspore, haematite and rutile (or anatase). The leaching of alkaline earths from ferruginous carbonate rocks resulted in the formation of brown laterites. Further weathering of laterites under restricted conditions gave rise to bleached clays.

DOLOMITE OF GHUNDAI TARAKO ($34^{\circ} 13' N$: $72^{\circ} 25' 15'' E$) PESHAWAR DIVISION

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Ghundai Tarako is a small hill on the boundary of Mardan district and Swat state and is mainly composed of marble. Four localities were observed to indicate high dolomite content. Composite samples were collected from each of these localities. The localities 2 and 4 have dolomite equivalent to 95.68%. Silica content ranges from 0.37 to 11.49%, whereas R_2O_3 from 0.85 to 0.88%. Other deleterious elements, like sulphur and phosphorous are either absent or present only in traces. Dolomites of Ghundai Tarako of localities 2 and 4 are of chemical grade and could be used in metallurgical and glass industries.

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STUDY OF PROPERTIES AND MINERALOGY OF A SALT RANGE HALOTRICHITE

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A naturally occurring alum from Karuli area (Choa Saidan Shah) District Jhelum has been studied for its physical characteristics and chemical composition. It has been identified as Halotrichite by DTA, Spectroscopy, and X-ray diffraction analysis. The assemblage in which it occurs consists of mainly halotrichite, pickeringite and small amounts of free aluminium sulphate, and rock fragments. The genesis of the deposit has also been discussed.

A STUDY OF PROCEDURES OF SELECTING AND CHANNELIZING SCIENTISTS FOR RESEARCH AND DEVELOPMENT

Part III.—Cyclic Variations in Output

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An attempt is made in this paper to make a fresh analysis of the productivity of scientists by studying the yearly variation of output of individual scientists. A sample of nine recognized Pakistani scientists has been taken, and the plot of yearwise research output of each one shows maxima and minima with a period of nearly six years. The data are then collected agewise into two groups, and the mean output for each group is found to show these cycles even more clearly.

The cycles for different groups can be brought into excellent agreement by bringing into coincidence the years of taking the Ph. D. The overall mean output curve shows the highest productivity between the ages of 36 and 46. A similar plot of the output of two relatively prolific Pakistani scientists shows maximum productivity from the age of 28 to over 43. Thus, the most probable range for greatest productivity is from 32 ± 4 years to 45 ± 1 years of age.

It is further concluded that (i) the output of scientists shows a six-year cycle, and they would do well to change their fields once every six years and their location once every twelve years, giving a turn-over rate of 8% per annum, and (ii) appointments to senior managerial positions in science should preferably be made after the age of 45 years, so as to allow the scientists' maximum productivity to be utilized in the laboratory.

SHORT COMMUNICATION

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CHEMICAL STUDIES ON SISYMBRIUM SOPHIA (SYN. DESCURAINIA SOPHIA)

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DETERMINATION OF ZINC IN INTERSTITIAL WATERS BY ATOMIC ABSORPTION SPECTROPHOTOMETRY

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THE AGE OF KAWAHGAR FORMATION

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