determined to devote my entire attention to the natural history, arts, ethnology, manufactures and raw products of Southern India, accepting only such specimens from other regions as may be sent as donations from time to time, and keeping them entirely apart from the main collections. The necessity for such a course is best illustrated by reference to the geological collections which, while abounding in a chaos of purchased and exchanged specimens of European fossils, is markedly deficient in specimens from the rich fossiliferous beds of the cretaceous system of Southern India." The policy which he thus established proved to be a sound one and, having been steadily pursued ever since, has resulted in the formation of the valuable South Indian collections for which the Museum is now known.

His wide interests and knowledge are indicated by the variety of subjects on which he wrote. These include coins, South Indian batrachians, fisheries and meteorites, as well as a number of papers on Anthropology; and under his guidance all sections of the Museum underwent great development, and the Connemara Public Library was founded with the Museum Library as its nucleus.

From September 1891 to November 1893, he officiated as Reporter on Economic Products to the Government of India in Calcutta. After his return to Madras he was appointed Lecturer in Comparative Anatomy at the Medical College for the year 1895-96, in addition to his permanent appointment. In 1901 he was similarly appointed Superintendent of the Ethnographic Survey of the Madras Presidency, which post he held till its termination in 1909. He finally retired in July 1910, but was absent on leave for some time prior to this.

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Henry Fairfield Osborn.

WE regret to announce the death, at the age of 78, of Henry Fairfied Osborn, the eminent Palæontologist, well known for numerous publications, among which may be mentioned, "The Age of Mammals" (1911), "Huxley and Education" (1920), "Men of the Old Stone Age" (1915), "Origin and Evolution of Life" (1917).

Industrial Outlook.

Some Lines of Development of the Indian Paint Industry.

By N. Srinivasan, M.A.,
Department of Biochemistry, Indian Institute of Science, Bangalore.

THERE can be no doubt that the production of paint materials is a promising branch of Indian Industry. Its rise has been rather late; barely three decades have passed since it was initiated in the country. The first need of the industry in which practice has out-stripped theory, was a human one: experienced technicians. The second was special plant and machinery which constitute an important element in its establishment. These could not be met.

The advantages possessed by the Indian Industry, however, are many and obvious. It is well supplied with raw materials. It can depend on a large domestic market. Indian manufacturers could experiment under actual conditions to which they can adapt their processes. The creation of confidence in Indian manufactures, noticeable in recent times, is no small comfort to the industry. The Paint trade thus offers a great field of interesting possibilities for future accomplishment. It is true that, like many others, it has been through the trough of depression. But we are told there are indications of a return to a better trade. The new trend of industrial policy of the government is another healthy sign. The importance of technical research as a necessary aid to industrial progress has been realised since the days of the Holland Commission. The co-ordination of efforts in this direction under a unified control has also been very recently secured. With the establishment of a Central Industrial Research and Intelligence Bureau, might be said to begin a new chapter in Indian industrial development.

It may therefore be pertinent to take stock of what progress has been achieved in this particular branch; and indicate or reiterate those future lines of development which might yield to immediate enterprise and research. A detailed review of the

subject is not made. What is attempted is a selection for consideration of a variety of points. These have a general or particular interest when viewed from the following aspects:—(1) The Indian market for Paint products; (2) The natural resources available for exploitation; (3) The present state of technical efficiency in the country.

First take the raw materials. Among Paint vehicles the most important are Linseed and Tung oils. The position with regard to Linseed is strong. As for the other, great expansion is necessary to free the industry from Chinese supplies which are of bad quality and often adulterated. China wood oil possesses some unique properties and is an essential material in present day varnish making. Its ability to dry quick and its compatibility with synthetic resins are being exploited to best advantage. Another important property is its suitability for use with Rosin with which it gives the so-called Spar varnishes. This is of particular interest to the Indian Industry as Rosin is almost the only oleo-varnish gum available in the country. Rosin has hitherto not found favour as a good varnish-making material.

Experimental growing of Tung trees have been undertaken. It was found that the trees do well on Tea estates especially in Assam and Burma. The methods of cultivation of the plant in China are obscure. Systematic research in this aspect remains to be carried out; the soil conditions and methods of culture as affecting the yield of crop and processes of extraction and refining as influencing the quality of the oil. These studies would be of immediate value to the industry in its present endeavour to produce on an economic basis, oil of satisfactory quality. Trials of cultivation could be extended to other areas in the country.

Pigments play by far the most important rôle in Paint production. These could be classified under two heads, natural and chemical. The manufacture of pigments has mostly been undertaken by big Paint concerns for their use. The small consumer has hitherto been dependent on imports and these run high. The development of this line has attractive possibilities as pigments are used in other industries as well.

Among natural pigments, Barytes has a definite place in the stock of raw materials for the trade. The deposits in the Ceded Districts of the Madras Presidency and in Alwar are only too well known. Mainly through lack of initiative the available resources have remained unexploited. No export market can be found for the crude material. The extension of mining operations and the production of the material in various grades in a finely powdered form are most needed. That would destroy dependence on imports which still amount to more than half the consumption.

Lithopone is a chemically prepared white pigment which has assumed interest in recent times. Its advantages are many: excellent colour, great opacity, unique covering power, complete inertness and above all comparative cheapness. To-day its consumption rivals that of white lead. The production of this pigment which has yet to be undertaken in the country is important for the following reasons: It would stimulate mining to a larger extent, of the available deposits of barytes which constitutes the starting material for the manufacture of the pigment. The production of a variety of cheap paints with a Barytes-Lithopone base, particularly for the Indian market, remains to be carefully investigated. The recent tendency is to substitute the zinc oxide in enamels more and more by Lithopone and there is no prospect of the production of the oxide in the country. The complete absence of deposits of whiting—the base for the different types of water paints—would necessitate the substitution of Lithopone. Its unique opacity and covering power render possible its use in conjunction with large proportions of colloidal clay. Good white qualities of this material are forthcoming from different parts of the country. Lastly, mention might be made of the capacity of Lithopone to go with shellac varnishes to yield varnish paints which have special applications.

Lithopone is the mixed precipitate obtained by double decomposition of Barium Sulphide with Zinc Sulphate. Barium Sulphide could be produced by reduction of Barytes. As for the Zinc salt, one has to look elsewhere. It has been suggested that the blende from the Bawdwin mines of Burma can serve as raw material. In any scheme for the manufacture of the pigment there are two directions in which attention ought to be focussed: (1) The conditions of treatment of the precipitate so as to develop proper pigmentary properties. (2) The elimination of impurities for obtaining a light resistant material. Only then is standard Lithopone of commercial value possible.

Two other important whites are white lead and zinc oxide, the invariable constituents of exterior oil paints and enamels respectively. The raw material for their manufacture is again the mixed sulphide from Burma. White lead of satisfactory quality is being produced in the country from Burma lead by the precipitation process. There is no reason why production should not be increased. The outlook with regard to zinc oxide production by the direct process is discouraging. But the American method of preparation of cheap compositions containing basic lead sulphate and zinc oxide, straight from the mixed ore is deserving of careful consideration by the Indian Industry.

The greatest achievement in the line of white pigments has been the introduction of a white derived from Titanium. Almost a Laboratory curiosity some years back, to-day it is a bulk commodity with an annual output of 1,50,000 tons. Its strength, obliterating power, non-poisonous nature, complete inertness and above all versatility opened up entirely new fields for the industry. The raw material used is Ilmenite sand, of which the home reserves are estimated at 75 million tons. The export of the ore from Travancore began in 1922 and has expanded continuously. Attempts have yet to be made for utilising the same in the country. The process is well known. Present research must seek to eliminate impurities and elucidate the precise conditions under which the oxide develops proper pigmentary value. What is further needed is enterprise for starting a large modern plant with careful scientific control and intelligent commercial direction.

Passing on to the coloured pigments the most common are the earth colours. Red oxides of iron and yellow ochres of very good quality are available in the country and their production is continually on the increase. Umber and Sienna, which are of greater value are, however, surprisingly absent. These natural colours have the great advantage of being cheap. But they are available in very few shades. They lack brilliancy. uniformity and high staining power.

The artificial oxides of iron answer the demands of the industry for a better class of pigment materials. Their manufacture could be controlled and standardised. They are in addition much cleaner, possess better body and a finer texture. The synthetic oxides could further be used to tint natural ochres of low grade to improve their staining power. Their methods of preparation fall under two heads, the dry and the precipitation methods. In the dry method, ferruginous materials are calcined under controlled conditions. Precipitated hydroxide of iron is subject to treatments in the second method. Their manufacture merits enquiry. Although an attempt has been made in this direction, a great deal of work has to be done before standard shades of suitable quality are turned out.

The average consumer in most cases is content to buy dry colours and prepare the paint himself. The importance of their manufacture is thus easily realised. Many of the important pigments like Red lead, Prussianblue, Lead chromes, Brunswick green, and chromic oxide green whose manufactures have been attempted, call for increased production and great improvement in quality. The production of blacks of good staining power; cheap alkali resistant blues of the ultramarine type: organic Lake colours fast to light from coal tar dyes—these are lines which if pursued would confer great benefit on the industry.

The finished products of the Paint trade fall under one or other of the following classes: water paints; oil paints; lacquers, varnishes and varnish paints; Anti-corrosion paints; Enamels; Pyroxylin compositions and Synthetic finishes. From the point of view of the Indian Industry it may be useful to consider them under the following heads: (1) Those in which considerable progress has already been made. (2) Those which offer great scope for trial, experimentation and improvement. (3) Those in which there is little prospect of immediate commercial success.

Water paints, oil paints, lacquers, Spirit varnishes and Anti-corrosive compositions come under the first category. Among decorative paints, those thinned with water are the cheapest and deservedly popular. An ideal water paint should not rub off from the surface and withstand washing by water. It must be in dry powder form and miscible with cold water. Most of the commercial brands fall far short of this standard. It has been shown by the author[1] that highly satisfactory products could be obtained by using as binding medium a vegetable protein,—carbohydrate complex and as base, better grades of colloidal

[1] Ind. Pat. No. 20192, 1933.

clays with comparatively small proportions of Lithopone. These have the further advantage of being perfectly non-smelling during application or drying.

Emulsion Paints have always been of interest to the industry. Opinion is undivided as regards their future. The most practicable among them for the Indian market would be the Linseed oil—water-type. The author has succeeded in preparing compositions, suitable for application to wood or metal. These contain boiled or treated Linseed oil medium to the extent of 50% of the water vehicle The base is Lithopone reduced with Barytes. Zinc oxide is added in some cases in small proportions. The size is a protein—modified cellulose mixture, prepared straight away from indigenous vegetable sources by simple methods.[2] The paint is produced as a stiff paste and softens readily when thinned with water before application. It flows nicely under the brush, covers well and is water-proof.

Such a paint could be obtained cheap and is of importance therefore under present economic conditions. The thinning medium is entirely water. No special costly emulsifier is employed. The size which is formed as a precipitate during preparation is used wet and serves to emulsify the oil and bind the pigments to the surface. Colours, many of which result in wet methods, could be incorporated as such and their drying costs obviated. It must be admitted that as regards weathering properties, a regular oil paint scores over the emulsion one. But it is not always that a complete destruction of the paint film is awaited, for repainting to be undertaken. More often there is a liking for change of colour. The ease of making and brushing of the emulsion paint renders possible to finish the painting with greater despatch and thus save in time and labour. It is not unlikely that it is more economical than the ordinary type, when durability per unit of price is taken into account. Further it dries quick and can be applied even in unfavourable weather. It is non-smelling while applying and leaves little lingering odour. These are highly desirable features particularly in house painting where a minimum of inconvenience to the occupants would be desired. The emulsion paint imparts a pleasing and restful eggshell effect, which in recent times has preference over a bright gloss. The surface however lends itself to further varnishing if desired.

Oil paints have made considerable headway in the country, as their formulation is devoid of much technique. They are produced by grinding together a pigment or mixture of pigments with oil, adding driers and thinning suitably. A great impetus to manufacture has however been afforded by improvements of plant technique. The result has been the introduction of ready-to-use paints of great convenience to the consumer. To-day the demand is for a quick-drying paint and this can be met by many an expensive synthetic finish. Present efforts could therefore be largely directed towards methods of treatment of Linseed oil so as to endow it with quick-setting properties without sacrifice of durability, brushing and storage qualities.

The use of shellac in the industry has received considerable attention for some time. It is a subject in itself, of great importance as lac is a virtual Indian monopoly. Among the products, that in general use is French polish, a varnish for woodwork made up from shellac, a soft resin and methylated spirits. Spirit varnishes yield, with aniline dyes in alcoholic solution, coloured lacquers useful for wood, metal or leather goods. These varnishes could also be incorporated with pigments for production of glossy paints possessing quick drying properties. By far the largest consumption, however, is as Insulation varnish for application in the electrical industry.

In many of these directions lac is threatened by competition from synthetic substitutes. Being laboratory products, their supplies are regular, prices dependable, trade organised and above all, quality uniform. Their properties, largely under scientific control, could be varied to adapt them for purposes on hand. Research measures that have been adopted to resuscitate the Indian trade in lac are directed towards better production and improved manufacture. The aspect of improvement of the quality and quantity of lac has been carried out at the Research Institute at Namkum. More recently the technical side has come in for consideration. It embraces an extended study of the physico-chemical properties of lac, which largely determine its value; devising of methods to rectify the weaknesses of lac so as to meet the needs of the consuming industries; and finally,

[2] Ind. Pat. No. 20143, 1933.

exploring of new avenues for its applications. The close association of the industries, concerned in these studies, is a factor of no mean significance. The results will be watched with interest even by those who wish to preserve the field for demand of the material within the country.

Special paints for protection of iron work are made in large quantities and used. Mention might be made of oxide of iron and red lead paints and the more recent ones containing a metallic pigment like aluminium. Considerable attention has been devoted to the production of bituminous compositions for which sometimes extravagant claims are made. Many of them are compounded from Asphaltum, one or other of the artificial pitches and Linseed oil treated with Litharge, red-lead and a varnish-making gum. The thinner is usually turpentine.

High grade oleo-resin varnishes which would suit actual conditions, are still products of future manufacture. Progress in the line has been inconsiderable as their production is an art in which empiricism is the sole dictator. A varnish is obtained by cooking a drying oil like Linseed, with a varnish-making gum, adding proper driers and thinning. Experience alone can guide in the choice of ingredients and their manipulation, factors which decide the quality of the final product. The raw materials except the resin are found in the country. Success must depend therefore on patient formulations and practical trials.

Specially compounded varnishes serve as media for Enamels. These dry quick and give hard and durable surfaces with permanent gloss. The colours and pigments therein are in a much finer state of division than in ordinary Paints. An enamel which does not thicken and is satisfactory in several respects, can only result from a proper choice of the pigments for incorporation into the media whose preparation is as important. The field is open and offers ample recompense for adequate experimentation.

Synthetic and Pyroxylin finishes are infants in the trade. Though their production in Western countries rivals that of other materials, they are only of subordinate importance in the Indian industry. The Synthetic finishes are based on the manufacture of artificial resins, which could be dissolved in suitable solvents to yield media for paint varnish or enamel. What is aimed here is improvement over the natural products, with regard to adhesion, durability and gloss retention.

Pyroxylin finishes contain as media, low viscosity solutions of cellulose nitrate in various organic solvents together with a plasticiser like castor oil or triphenyl phosphate to render the film flexible. They could be coloured to form lacquers, combined with resins to produce varnishes and incorporated with pigments to give enamel paints.

A great drawback to the use of the above two modern finishes is their expense and as a consequence only a very limited market could be found for them. The problem of the solvents for use—many new ones have been introduced—has yet to be successfully solved by the Indian industry. Further their production calls for special technical skill of a high order. Their manufacture in the country may not therefore be assured of a welcome for some time to come.

"Vernalizing" and Crop Yields.

MR. T. Lisenko, the Russian scientist, announced before the recent Conference of the Soviet Academy of Agricultural Sciences, the results obtained by *vernalizing* a new process for seed regeneration possessing great potentialities for increasing crop yields and insuring against crop failures. The method which is applicable to all self-pollinating plants is to take the pollen from 100 to 200 plants of the same variety, mixing it with a brush and then dropping the mixed pollen into the flowers after bending back the petal-scale with pincers. The seeds obtained are first moistened and then submitted to different degrees of heat before sowing. By this simple process it is possible to obtain plants better adopted to the region than their parents. *Vernalized* wheat matures 3 to 7 days earlier than untreated seed: the treated seed also sprouts earlier. 1,500,000 acres in the Kuibesheff (Samara) Province have been planted with *vernalized* wheat and 1,000,000 acres in the Ukraine Province. In the latter Province, 3,000 acres were planted with *vernalized* cotton seed and the results were, in all cases, satisfactory—the crops developed earlier and the yields were higher as compared with untreated seed.