

may jump 16 feet perpendicularly; but such jumps are rare, and he can only state with certainty that it has taken place at the Hellefos, in the Drams River, at Haugsend, where two great masts have been placed across the river for the study of the habits of the salmon, so that exact measurements may be effected. The height of the water in the river of course varies, but it is as a rule, when the salmon is running up stream, 16 feet below these masts. The distance between the two is $3\frac{1}{2}$ feet, and the Professor states that he has seen salmon jump from the river below across both masts. As another example of high jumping, he mentions some instances of Carratunk waterfall, in Reumbec, in North America, where jumps of 12 feet have been recorded. Prof. Landmark further states that when a salmon jumps a fall nearly perpendicular in shape it is sometimes able to remain in the fall, even if the jump is a foot or two short of the actual height. This, he maintains, has been proved by an overwhelming quantity of evidence. The fish may then be seen to stand for a minute or two a foot or so below the edge of the fall in the same spot, in a trembling motion, when with a smart twitch of the tail the rest of the fall is cleared. But only fish which strike the fall straight with the snout are able to remain in the falling mass of water; if it is struck obliquely, the fish is carried back into the stream below. This Prof. Landmark believes to be the explanation of salmon passing falls with a clear descent of 16 feet. The professor believes that this is the extreme jump a salmon is capable of, and points out that, of course, not all are capable of performing this feat.

IN the new part of the *Transactions* of the Essex Field Club (vol. iv. part 1) the first and perhaps most interesting paper is Prof. Boulger's presidential address on the "Influence of Man upon the Flora of Essex."

ACCORDING to the *Chinese Recorder*, Dr. Wallace Taylor, a missionary doctor of Osaka, Japan, has made important discoveries regarding the origin of the disease *kakké*, or *beriberi*, as it is known in Ceylon. He traces it to a microscopic spore, which is often found largely developed in rice, and which he has finally detected in the earth of certain alluvial and damp localities.

WE have received from Denver the first volume of the *Proceedings* of the Colorado Scientific Society. Denver as a western mining camp, with an evil reputation, and Denver the capital of the State of Colorado, are places separated by ages of civilisation; but mining is prominent in both. The members of the Scientific Society appear from the list to be mainly civil or mining engineers, metallurgists, geologists, assayers, &c., and the papers are largely on these subjects, e.g. the estimation of arsenic, and of copper; the ore deposits of the Summit districts of Rio Grande county, Colorado (the principal paper in the volume), löllingite, &c. There are, however, other papers: there is the report by a commission of the society on the Artesian wells of Denver, a paper on extinct glaciers of the San Juan mountains, while one of the members, Mr. van Diest, read several papers on subjects connected with the Malay Archipelago, such as the formation of hills by mineral springs in the Island of Java, the geology of the Sumatra, and the method of mining there 250 years ago, the methods of smelting employed by the Chinese at Banka, &c. There is certainly plenty of vitality in the new society, and doubtless it will grow with the growth and strengthen with the strength of the magnificent State from which it takes its name.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mr. J. S. Stevens; two Turtle Doves (*Turtur communis*), European, presented by Mr. J. Hare; four Martinican Doves (*Zenaida martinicana*), a Moustache Ground Dove (*Geotrygon mystacea*), four Dominican Kestrels (*Tinnunculus dominicensis*), a Green Bittern (*Butorides virescens*) from

the West Indies, presented by Dr. A. Boon, M.R.C.S.; a Golden Eagle (*Aquila chrysaetos*) from Perthshire, presented Mr. Chas. J. Wertheimer; two Larger Hill Mynahs (*Gracul. intermedia*) from India, presented by Mr. Thomas Hudson; an Indian Python (*Python molurus*) from India, presented by Mr. Harrington Laing; four Proteus (*Proteus anguinus*), European, presented by Mr. Cook; a Red-headed Cardinal (*Paroaria larvata*), a Yellow Hangnest (*Cassicus persicus*) from South America, deposited; a Vulpine Phalanger (*Phalangista vulpina*), two Snow Birds (*Junco hyemalis*), a Northern Mocking-bird (*Mimus polyglottus*), bred in the Gardens.

ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, AUGUST 9-15

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on August 9

Sun rises, 4h. 38m.; souths, 12h. 5m. 13' 6s.; sets, 19h. 32m.; decl. on meridian, 15° 45' N.; Sidereal Time at Sunset, 16h. 46m.

Moon (New on August 10) rises, 3h. 19m.; souths, 11h. 1m.; sets, 18h. 34m.; decl. on meridian, 15° 37' N.

| Planet | Rises | | Souths | | Sets | | Decl. on meridian |
|-------------|-------|----|--------|----|------|----|-------------------|
| | h. | m. | h. | m. | h. | m. | |
| Mercury ... | 7 | 20 | 13 | 45 | 20 | 10 | 4 13 N. |
| Venus ... | 7 | 3 | 13 | 47 | 20 | 31 | 7 55 N. |
| Mars ... | 0 | 52 | 9 | 12 | 17 | 32 | 23 48 N. |
| Jupiter ... | 6 | 45 | 13 | 34 | 20 | 23 | 8 48 N. |
| Saturn ... | 0 | 57 | 9 | 6 | 17 | 15 | 22 29 N. |

August 9, 10, and 11.—Principal nights for observation of the August (Perseus) meteors.

| August | h. | |
|--------|--------|---|
| 12 ... | 2 ... | Jupiter in conjunction with and 2° 30' north of the Moon. |
| 12 ... | 9 ... | Mercury in conjunction with and 1° 55' south of the Moon. |
| 12 ... | 12 ... | Venus in conjunction with and 2° 13' north of the Moon. |

DR. PERKIN ON THE COAL-TAR COLOURS¹

Anthraquinone Series

I MUST now draw your attention to the important class of colouring matter compounds obtained from anthracene or anthraquinone.

Alizarin and the other colouring matters related to it form one of the most important branches of the coal-tar colouring industry, and is one of special interest, because alizarin was the first instance of the production of a natural colouring matter artificially. It will be quite unnecessary for me here to say much about the madder root, which was the original source of alizarin, and was grown in such enormous quantities, but now is nearly a thing of the past; nor will I enter into the early chemical history of alizarin, and all the laborious work which was bestowed upon it by Dr. Schunck and others. As you are probably all aware, the relationship of alizarin and its formation from the coal-tar hydrocarbon anthracene was the result of the labours of Graebe and Liebermann, the researches which culminated in this being of a purely scientific nature. The original process for obtaining it has, however, not been found of practical value, but a new one in which sulphuric acid could be used in place of bromine was afterwards discovered by Caro, Graebe, and Liebermann in Germany, and by myself in this country, apparently simultaneously. A second process was also discovered by me, which was worked nearly all the time I was engaged in this industry. In this dichloranthracene was used instead of anthraquinone, and the product thus obtained yielded colours of a brilliancy which it has been found, even to the present time, difficult to match by the anthraquinone process.

At the time of the discovery of artificial alizarin, anthracene

¹ The President's Address at the annual meeting of the Society of Chemical Industry (not the Institute of Chemistry as stated last week). Continued from p. 307.

was not prepared by the tar distillers, as it had no application, and very little was known about it. It was discovered in 1832 by Dumas and Laurent. In 1854-55, when studying under Dr. Hofmann, I worked with it for some time, but my results were never published, because, owing to the erroneous formula given for it by Dumas and Laurent, which was accepted, my results would not fit in; nevertheless the information obtained afterwards proved of great value to me, although at the time the labour spent appeared to be lost labour, showing the value of research even when not successful. The formula of this hydrocarbon was not established until 1862, when it was studied by Dr. Anderson. This was only six years before the discovery of Graebe and Liebermann, and, had not the formula of anthracene been established before these chemists commenced their work, the relationship of alizarin to it would not have been discovered, and up to this day it is possible that this artificial alizarin industry would not have been in existence. Researches like that of Dr. Anderson I have often heard spoken of slightly, because they don't bear much on their surface; but who knows what such work may lead to? Earnest workers cannot be too much encouraged.

As anthracene was not a commercial product, it was necessary to experiment on its production before alizarin could be manufactured, and not only on the best methods of getting it, but also to get a rough idea of how much could be produced, because unless the hydrocarbon could be obtained in large quantities, artificial alizarin could not compete with madder. In our works at Greenford Green we commenced by distilling pitch; but afterwards tar distillers were induced to try to separate it from the last runnings of their stills by cooling and then filtering off the crystalline products which separated out, and in fact visits were paid to most of the tar distillers of the United Kingdom, others being corresponded with on the subject, and the result was that in a short time such quantities came in that the distillation of pitch was abandoned. And although much doubt and anxiety prevailed at first as to the possibility of getting a sufficient supply of this raw material, at the present day there are about 1000 tons of commercial product (about 30 per cent.) produced in excess of the requirements, the annual production in the United Kingdom being estimated at about 6000 tons 30 per cent., or nearly 2000 tons pure anthracene.

Although the colouring matter obtained from anthraquinone or dechloranthracene was at first simply considered as alizarin more or less pure, yet on investigating the matter it was soon found that it contained other colouring matter. To this I drew attention in 1870 (*J. Chem. Soc.* xxiii. 143, footnote), and in 1872 gave the analysis of a product which I named anthrapurpurin, followed by a more extended account a year afterwards (*J. Chem. Soc.* xxv. 659, and xxvi. 425). This was called anthrapurpurin; because it is an anthracene derivative having the formula of purpurin, with which it is isomeric. In the latter paper I also referred to another colouring matter dyeing alumina mordants of an orange colour (*J. Chem. Soc.* xxvi. 425). It was also shown that anthrafluoric acid when fused with alkali gave a colouring matter behaving with mordants in the same way (*J. Chem. Soc.* xxvi. 20), and which has proved to be the same body. This latter reaction was afterwards more fully studied by Schunck and Roemer, and the colouring matter produced by it was shown also to have the formula of purpurin; they therefore called it flavopurpurin (*Ber.* ix. 678), so that the colouring matters formed have proved to be three in number—alizarin, anthrapurpurin, and flavopurpurin, all of which are valuable dyes, whereas in madder root there is only alizarin and purpurin, the latter being of only secondary value. This can now also be produced from anthracene. The researches which have been reached on the subject of the conditions under which these different colouring matters are formed, have led to the discovery of methods for their separate production, so that in artificial alizarine, which name commercially embraces all these colouring matters, both mixed and separate, we have more than a simple replacer of madder root, and as these colouring matters just referred to can be applied with the same mordants, varieties of styles of work can be produced by the calico printer and dyer which before were unknown. Anthrapurpurin is, I believe, of as great importance as alizarin itself, and used with it increases its brilliancy, and alone gives very brilliant scarlet shades.

Artificial alizarin was first produced commercially in this country by my firm at Greenford Green in 1869; when one ton was produced in 1870, forty tons were made in 1871, 227 tons, and

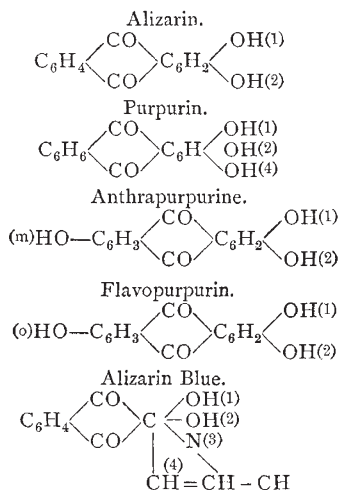
so on increasingly. It was not produced on the Continent until 1871, when, according to Graebe and Liebermann, 125-150 tons were made. These weights do not apply to dry colour, but to paste.

I cannot go into any lengthened account of the chemistry of this industry here; its development, however, has kept pace with theoretical investigations, in some cases it may be said to have forestalled it. For example, in the old methods of working, more anthrapurpurin than alizarin was produced; the conditions required to modify this were found out by experiment. According to all our previous knowledge as to the introduction of hydroxyl into a body by the fusion of its sulphonic acid with alkali, a monosulphonic acid should give a monohydroxyl compound, and a disulphonic acid a dihydroxyl compound. Therefore to produce alizarin, which is a dihydroxyl compound, an anthraquinone disulphonic acid was thought to be the proper thing to use. By experience this was gradually found to be incorrect, a monosulphonic acid being required to produce alizarin, a disulphonic giving anthra or flavopurpurin, the colouring matter not being due to the primary but to a secondary reaction as was afterwards shown by research—the mono and dioxanthraquinones (the latter known as anthraflavic and isoanthraflavic acids) being the first products of the reaction, and then undergoing oxidation by the caustic alkali employed, and then yielding the corresponding colouring matter, a portion of the products, however, being at the same reduced back to anthraquinone.

A very important improvement preventing this loss by reduction was discovered by J. J. Koch, who found it might be avoided by the use of a small quantity of potassium chlorate with the alkali used in the fusion.

The amount of caustic soda used in this industry is very large at the Badische Aniline and Soda Fabrik—and, I believe, elsewhere—it is made on the spot; and I must say the cleanly way in which alkali is made in the above works contrasts very favourably with what I have seen in some of the alkali works in this country.

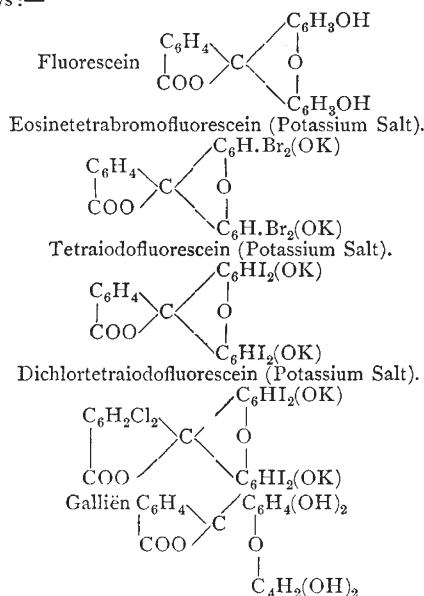
Like rosaniline, alizarin has now become a material for preparing other colouring matters. Of these there are two in use, viz., nitroalizarin, which gives orange-yellow shades with alumina mordants, and alizarin blue, a remarkable compound prepared from nitroalizarin by treating it with sulphuric acid and glycerine. This gives shades of colour like indigo. When first discovered, considerable difficulty was found in its application, on account of its insolubility; it has since been found to form a soluble compound with sodium bisulphite, and by this means its application has become much easier. The constitution of the colouring matter derived from anthracene may be represented as follows:—



These colouring matters under the name of artificial alizarin are the most important of the coal-tar colours, their money value amounting to more than a third of the entire value of all the colours produced in the industry, and at present the price of artificial alizarin compound tinctorially is not more than one-fourth of that which madder or garancium ordinarily were before their production. There are now three works producing it in this country, but the bulk of that used still comes from Germany.

Phthalines.—The discovery of this class of bodies dates back to 1871, and was the result of the investigation of Baeyer. He found that phenols unite with a number of polybasic acids and with aldehydes, with separation of water when the mixture is heated alone, or with glycerol and sulphuric acid, the compounds formed not being ethers. Those produced when phthalic anhydride is employed and which embrace those of practical value, are called phthalines. The first of these discovered by Baeyer was gallein (*Ber.* iv. 457), produced by heating pyrogallol with phthalic anhydride; its formula is $C_{20}H_{14}O_5$; by reduction it loses the elements of water and with hydrogen forming *cerulein*. These colouring matters, which for a long time remained unnoticed, are now being extensively used.

Later, in 1871, Baeyer discovered resophthalin, or fluorescein (*Ber.* iv. 555). This substance, which is remarkable for its yellowish green, fluorescence, dyes silk and wool yellow, but does not combine with mordants, and is not a very useful dyeing agent. But it was discovered by Caro in 1874, the subject being afterwards worked out jointly with Baeyer, that fluorescein when brominated yielded that beautiful dyestuff now called *eosine*; this was introduced into the market in July, 1874. Other substitution products were then studied, and the iodine product was found to give bluer shades of red than the bromine. One of the most beautiful colours of this series is the dichlorotetraiodofluorescein, in which dichlorophthalic anhydride is used in its preparation. It is called *phloxine*. The methyl ether of eosine and its nitro derivative also have become commercial articles. These bodies are now manufactured in a practically firm condition. Their structure has been made out by research to be as follows:—



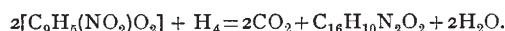
The introduction of these colouring matters had a great influence on the manufacture of phthalic acid. This acid, it will be remembered, was proposed a good many years since for the production of benzoic acid, which was largely in demand for the manufacture of aniline blues, phthalic acid when carefully treated with lime yielding calcium benzoate. But as phthalic acid was required to be produced in an extensive way, new experiments had to be made on the subject. The difficulties connected with this were surmounted by the Badische Aniline Fabrik, who are now the chief manufacturers of this body and its anhydride, which is the substance required; when freshly prepared it is one of the most beautiful products one can see.

Dichlorophthalic acid is now also manufactured for the preparation of the bluish shades of fluorescein derivatives already referred to. But this is not all; it was not only necessary to produce this anhydride in quantity, but it was necessary also to produce *resorcinol*. This substance was originally prepared from galbanum by fusing it with potash, or by distilling brazilin, &c., both technically impractical processes. It was afterwards produced by fusing various halogen derivatives of phenol and benzene sulphonic acid with alkali; these also were not practical processes. It was, however, eventually found that it could be

produced by fusing metabenzenedisulphonic acid with potash, the original observation being made by Carrick; and by this process this product, which was a rare compound, is now manufactured and has become a common one, being produced in very large quantities.

Indigo Series.—Indigo is too well known a substance for me to make any remarks in reference to its history as a colouring matter, and with reference to the chemical side of the question I suppose few substances have had more work bestowed upon them than this body, so that I must confine any few remarks to its artificial formation. There is one point of interest, however, connected with indigo, and that is that it was the original source of aniline, this base being discovered in the products of its destructive distillation by Unverdorben, in 1826, as already referred to.

Notwithstanding the large amount of work which has been bestowed upon this colouring matter, its constitution has only been lately arrived at, and for this, and the methods of its artificial formation, we are indebted to the beautiful and laborious researches of Baeyer. The first process for its artificial production was patented by Baeyer in March, 1880. The process consists in preparing orthonitropropionic acid and acting upon it in presence of an alkali, with a reducing agent, such as grape sugar, xanthate of sodium, &c.

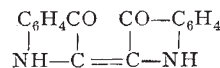


This process renders the application of artificial alizarin very easy to calico printing, because the products can be applied to the fabric and the reaction then completed, and thus the indigo is formed and fixed in the fibre, and this process is in use in some of the printworks of Mulhouse, where there is a continued though small demand for nitroorthopropionic acid. Other processes have been discovered by Baeyer for the formation of Indigo; he has found that it can easily be formed from orthonitrobenzaldehyde by condensation with bodies containing CH_3CO group, such as acetone.

Hitherto this artificial formation of indigo has not met with much practical success. This does not arise from difficulties in its manufacture, but in its cost compared with natural indigo, which is a very cheap dyestuff.

So far as it has been manufactured, however, the possibility of this has been entirely dependant upon scientific research disconnected with its study. To prepare nitropropionic acid it is necessary to begin with cinnamic acid as a raw material. This acid, until 1877, was only obtained from certain balsams, and was a very costly material. It was then discovered that it could be produced with comparative ease by the action of acetic anhydride and an acetate on benzaldehyde (*Fourn. Chem. Soc.* xxxi. 428). Caro afterwards found that this process might be simplified by heating a mixture of benzylidene dichloride with sodium acetate, and it is by this process that it is now prepared.

The constitution of indigo Baeyer represents as follows:—



Several derivatives have been made which are interesting dyes, such as methyl indigo, tetrachlor indigo, etc.

Azo compounds.—The commencement of the history of the azo colours in an industrial sense has little to do with the theoretical side of the question, the early products being the offspring of empirical observations, and in no way connected with the theory of the diazo compounds, a condition of things very different from that now existing. Time will not allow me to enter into the beautiful work of Griess, much of which will be found in the *Philosophical Transactions* for 1864.

The first definite compound of this class, shown to possess dyeing powers, was a substance discovered by Prof. Church and myself, known first as nitrosonaphthalene, then as azodinaphthyl-diamine, but now called amidoazonaphthalene. This substance, however, was of no practical value, because its salts, which are violet, cannot exist except in the presence of a certain amount of free acid. This substance has since been found of value in the preparation of the Magdala red.

The first substance of this class sent into the market was the phenylic analogon of amidoazonaphthalene by amidoazobenzene, which was discovered by Mène. It was introduced by Nicholson, who prepared it by a process which has not been published. It was afterwards patented by Dale and Caro, in 1863. This was a yellow dye, but did not demand success, because of its vola-

tility. It has, however, since become useful for the manufacture of induline.

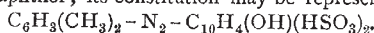
The first really successful azo colour was Manchester and Bismarck brown (triamidoazobenzene), which is produced by the action of nitrous acid on metadiaminobenzene.

The next important step took place in 1876, by the discovery of chrysoidine, by Caro and Witt. Independently this product is prepared by the action of diazobenzene on metadiaminobenzene.

About this time the subject began to be worked out on a scientific basis, and since then the number of diazo dyes produced is marvellous, and it will be useless for me to do more than to refer to one or two of the most important. About this period also the value of the sulpho group, began to be realised, and this has greatly added to the value of these dyes.

The first use of the sulpho group in relation to azo colours was in connection with amidoazonaphthalene, patented by myself in 1863.

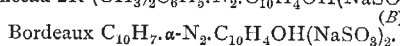
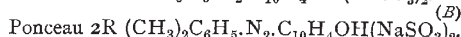
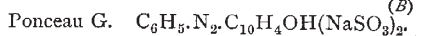
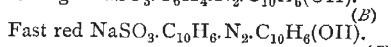
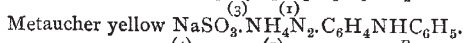
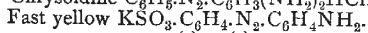
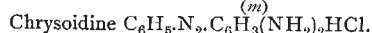
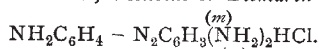
During the early history of coal-tar colours, innumerable experiments were made with naphthalene derivatives to produce colouring matters, but no results of any value were obtained; the experiments were mostly made with naphthalamine. The first colouring matter that was obtained from it that was of value was Martin's yellow, a dinitronaphthol. After this came the Magdala red, which was not much used. The principal development of the coal-tar colours of late years has, however, been in connection with diazo reaction. In these reactions naphthol is much used, and this product, which a few years ago was unknown, is now manufactured by tons by fixing the naphthalene sulphonic acid with alkali, and is produced at a few pence per pound. Most of the azo colours produced from benzene derivatives are of a yellow or brown colour, but, by taking products of a higher molecular weight, colours of different shades of red are produced. The one which has commanded the greatest success is the scarlet, first known as Meister scarlet, produced by the acting of diazoxylene chloride on the disulphonic acid of β -naphthol; its constitution may be represented thus:—



And in the formation of bluer shades, diazocumene chloride is used. The cumedene used is now made from xylidene, by the beautiful reaction of Hofmann's, in which an alcohol radical associated with the nitrogen becomes that element, and enters with the hydrocarbon radical. These scarlets have had a very injurious influence on the cochineal market, and have in many cases displaced it.

If α -diazonaphthalene chloride be used instead of the xylene or cumene compounds, the colour known as Bordeaux is produced. Then, again, where derivatives of α -naphthol are used, different results are also obtained, so that great varieties of products can be produced. The preparation of these azo colours is a matter of much simplicity, and colouring matter being precipitated in bringing the products together, and, moreover, they can be produced in many theoretical quantities; hence they are remarkably cheap dyeing agents. The following are the formulæ of some of these azo dyes:—

Manchester Brown, Vesuvius or Bismarck Brown.—



From which it will be seen that the colour changes from yellow to red and claret by the increase of the molecular weight of the radicals introduced, and also by the relative position occupied by the group, &c.

Products of the quinoline series have of late been claiming attention in relation to colouring matters. It will perhaps be remembered that, in the early days of the coal-tar colour

industry, a beautiful blue colour belonging to this series, discovered by Greville Williams (*Chem. News*, Oct. 11, 1860, 219), was introduced. This substance was called cyanine. The employment as a dye for silk at first produced quite a sensation, on account of the beauty of the colour; but unfortunately it was too fugitive to be of any practical value. Recent researches have shown that chryaniline is also to be regarded as a body of the chinoline class. Alizarin blue, and also the beautiful yellow dye obtained from acetanilide by Fischer, and known as flavanilin, are found also to belong to this class of substance.

Other colouring matters which have long been prepared from quinoline direct might be referred to did time permit. The peculiar green which is produced by the condensation of tetramethyldiphenylketone with quinoline is of interest, because the introduction of this quinoline has a very different influence on the resulting colouring matter to that of other groups containing amidogen—in fact, it appears to act more like the phenyl, as the green is very analogous to benzaldehyde green.

There is a very interesting new manufacture growing out of the coal-tar colour industry, and that is, the preparation of derivatives of quinoline as substitutes for quinine. I have mentioned that much work has of late been directed to the study of quinine itself, and although the artificial formation of this substance has not yet been discovered, new bodies have been obtained during these investigations which are thought to possess valuable medical properties. This is rather a remarkable development from this industry, seeing that it was owing to experiments made on the artificial formation of quinine that it owes its foundation.

There is another peculiar colouring matter I have not yet referred to, peculiar—as it contains sulphur. I refer to methylene blue, a very valuable dye, the constitution of which has been so well worked out by Berntsen, but I feel I must be content with this slight reference to it.

As I have shown, the coal-tar colour industry originated in this country, where for some time it was solely carried on. The second impulse was from France in the discovery of magenta and its blue and purple phenylic derivatives, which were soon brought to a state of great purity in this country. The Hofmann violets were then discovered and produced also in this country, several other colours being perfected and largely used. By this time the manufacture of coal-tar colouring matter had made some progress in Germany and Switzerland; crude products in a cheap form were first made, but improvements soon followed.

The subject of these colouring matters was taken up with great earnestness in the German laboratories, so much so that it was stated at one time that this industry was acting injuriously to science, as it had diverted an undue amount of attention from other subjects. Time has, however, proved the groundlessness of this statement. This laboratory work, as well as research work generally, fitted a number of highly-trained chemists to enter the works, when they soon improved the processes, and thus they were able to produce products of a quality to compete with those of English manufacture, which had, owing to their purity, given superior and more reliable shades of colour in the hands of the dyer; and the result of the application of this scientific labour to this industry is that Germany produces products of the highest class and at the lowest price. The fact that Germany is now the head-quarters of this industry, raises the important question, Why has England allowed this state of things to come about? All the raw materials are produced in this country, both the products from coal and the other chemicals required, and, as we have seen, the industry originated and was first carried on here, and, in addition, we are the greatest consumers of the colouring matters. This fact is well worth considering, and it is many-sided. In my opinion, the Patent Laws, and the difficulty of preventing infringements from abroad, was one cause which may have prevented this country from maintaining its first position.

When speaking of the early history of the first coal-tar colour, mauvein, I referred to this class of infringement and how it was first met by the proceedings taken against the agents employed in this country, and this course was so far successful, but only pointed out how easily the law could be evaded if foreign manufacturers gave up responsible agents and sold direct to the consumers. Having no duties on such articles, no assistance could be obtained at the Customs, and the colouring matters were generally declared under the name of vegetable dyes or extracts, so that it was impossible to stop them entering the country, and

even when found, owing to the onus of proof of their being manufactured by the patentee's process laying with the patentee, an almost insurmountable difficulty was raised, as in most cases no traces of the products used in the preparation were left in the colouring matter. The only other proceedings which could be instituted were against the consumer; here again the difficulties were practically insuperable.

In most cases the consumers were using the patentee's product to some extent, and it was impossible to know to what extent, in fact, without going into the many details connected with this point, it may be assumed that in most cases proceeding against a consumer of this kind of article is detrimental and practically useless.

The result of this infringement, by importation from abroad, is that a patentee had to compete against all other manufacturers with the exception of *his own countrymen*.

There can be but little doubt that this state of things has had much to do with preventing the development of this industry, and crippling enterprise in this country, as it prevented manufacturers even from working under royalties, there being no security whatever except in name. Again, the fact that a foreigner could take a patent in this country, manufacture in his own country, and send the product here, was a great source of loss and mischief to our trade. The new patent laws may probably alter this, but still the difficulty of importation in defiance of patent right still remains.

There is another matter which tells much against this country—namely, that we are not able to export colour to foreign countries upon the same conditions as foreign manufacturers can into this, because we are met with import duties which handicap us to a prohibitive extent, whereas the foreign manufacturer, being protected in his own country, may maintain his prices there and sell at a lower price in this country; but what is still more injurious, he may dispose of surplus production in this country at or even below cost price. The injurious effect of such a course upon our market can be easily understood by business men, and I need not go into it here. These are matters our manufacturers have to contend with, and cannot help themselves; there is, however, one matter in which they are undoubtedly at fault.

We find that in Germany the manufacturer understands the value of well-trained chemists, and sympathises with them; they also realise the value of theoretical chemistry—this is a condition of things we don't find in this country.

Unless I am mistaken, the coal-tar colour industry has acted as the great stimulus to the development of general chemical industries of Germany, and these, by starting with so much scientific aid as they have called to their assistance, have made an amount of progress during the last twenty-five years which is most remarkable. Up to that time England had been the seat of most of the large chemical industries, and the success which we have had appears to me to have produced a feeling of false security, and more attention has been paid by the heads of firms to the markets than to the chemistry of their manufactures.

I believe that thirty years ago there were very few chemists employed in chemical works, either in this country or on the Continent. Now there are very few without them; but in this country they are far less numerous and much less efficient than in Germany, and for this our manufacturers are to a great extent responsible. I am told that at some of our large chemical centres, the chemists, or so-called chemists, are sometimes paid not more than could be earned by a bricklayer. If such openings are put by manufacturers before young men, their parents are not likely to give them an expensive scientific training. If they get any they are not likely to continue it longer than enough to do analysis very imperfectly, say by studying for about nine months. An ordinary tradesman would not be considered efficient unless he passed a much longer apprenticeship than this, but I know teachers complain that it is difficult to get students who are to be works chemists to stay longer than this. The result is that when really efficient men are wanted, they are not to be found, and they have to be got from abroad. In my address to the Chemical Society last year, I referred to the past neglect of research at our chemical schools, so that I need not speak further on that aspect of the subject here, though it is an important one in relation to our industries.

There is no chasm, as we have already seen, between pure and applied chemistry; they do not even stand side by side, but are linked together, so that a technical chemist needs to be a thorough chemist, and unless we employ such men

we must be at a great disadvantage in relation to foreign manufacturers.

This brings me to a subject which has occupied much attention of late, but I fear is much misunderstood by the public generally. I refer to the teaching required by technical men, or technical education. The general idea is that it should be carried out in what may be called its narrow sense. That is to say, that it should be in relation to the existing manufactures and the present methods employed in them. Whereas there can be no doubt it will be of small service unless it is carried out on a very broad and scientific basis. As it is, the processes which are *publicly* known and taught, are more or less antiquated, simply because improvements are naturally kept secret as long as possible, and therefore to spend a large amount of time in studying details of old processes would manifestly be a great waste of power, and I am glad to find that this view of the matter is held by some of our leading chemical manufacturers. Our chemical industries are now undergoing such rapid and radical changes, owing to the advances in scientific discovery, that this cannot be too much borne in mind. To train a young man as a technical chemist, I consider, requires first that he should have a thorough knowledge of chemical science and know how to use it by conducting research, that he should have a general knowledge of those sciences which are connected with it, such as physics, and of those subjects required by all manufacturers, such as engineering, mechanics, &c., and also study the way chemical operations are carried out on the large scale, not in one branch of manufacture only, but in many.

With men in our works so trained, and of course possessing the suitable natural qualifications, we might expect to see our chemical industries make good progress and keep well to the front, but such a course of study could not be gone through in twelve months, nor would men so qualified be content to receive the remuneration for their services which is now given.

The proposed course for technical chemists at the Central Institute of the City and Guilds of London Institute is to occupy three years, the students having already devoted one year to elementary chemistry this makes four years of study, and this is hardly sufficient. It is to be hoped that those who are to be principals, or to take responsible positions in works will avail themselves of the opportunities afforded by this Institute or get some similar course elsewhere, so that we may have efficient men in this country to advance our chemical industries, and also that the value of such chemists may be appreciated in this country.

The employment of well-trained chemists in Germany, and the division of labour which results from this, has no doubt been one of the chief causes of the great success not only in the colour but in other chemical industries. In this country it not infrequently happens that an inventor, or the head of a firm, feels that no one can do the work he is connected with like himself, which is probably quite true; but at the same time he forgets that one person is not able to attend to the details of a number of processes adequately from sheer want of time and strength; if, however, properly qualified men can be set over them, although they may be slower and less capable than himself, yet having less divided minds and more time they are able to work out the details under his direction with much more success than he could alone, as well as see things from other points of view, and then greater perfection will be attained. I think this is a matter deserving of careful attention on the part of our manufacturers.

I have now given a very brief, and therefore a very imperfect outline of the history of the coal-tar colour industry, an industry to which none other can be compared for its rapid progress. I have drawn your attention to the fact that it is the offspring of scientific research, that in return, as I before stated, it has in many cases given a fresh impulse to research by giving the chemist new products, and also by opening up new subjects of theoretical interest for consideration, and from the fruits thus resulting again reaping further benefit. This linking together of industrial and theoretical chemistry has undoubtedly been the great cause of its wonderful development. We now have not only all the colours of the rainbow, but we have also the more sombre, but often not less useful, colours, and, moreover, there are also great varieties of products of similar colours possessing different properties which fit them for special uses. This industry is also one of no mean dimensions. I have not been able to get any very recent statistical information on this subject, but notwithstanding the great reduction of prices of the products of late years, yet owing to the extended development it has undergone, the value of the annual output has probably

increased, and not declined, and from what information I have on the subject, I should say it is perhaps not less than 3,500,000.

In my remarks I have also been led to refer to some of the points connected with the migration of this industry from this country to Germany and the probable influence our patent laws had upon this, to the matter of technical education, and the employment of high-class chemists in chemical work. This latter subject is undoubtedly of great importance, and requires the earnest consideration of our manufacturers. It is found profitable to employ chemists of this class on the Continent, surely it should be found equally profitable to employ them here. In conclusion, I am happy to say there are signs of the coal-tar colour industry returning to our country, in part at any rate, especially in relation to alizarin, for which there are now three large works in existence, and the production of other colouring matters is also increasing.

FAUNA OF TRANS-ALAY

IN the *Izvestia* of the Russian Geographical Society (xx. 6) we find an interesting paper by M. Grum-Grzimaïlo, who has journeyed in the mountains north of the Alay region of the Pamir, chiefly for zoological purposes. The immense cultivated loess-fields of Osh, devoid of trees, yielded poor zoological results. Only a few uncultivated places had in the spring a rich fauna: great numbers of birds, various *Colubridæ*, the *Pseudapus pallasi*, tortoises, immense numbers of *Bufo variabilis* were met with. Here the author gathered a very rich collection of Lepidoptera; also *Zamenis kaufmanni*, *Taphromeloron lincolatium*, *Elaphis diene*, *Eryx jaculuj*, and many others. In the middle of May all these disappeared under the burning rays of the sun. On the way to Vadil several species which were not found later on were met with, such as the *Trigonocephalus halis*, the *Anthocaris pyrothæ*, and several others. The neighbourhoods of Vadil yielded nothing interesting at that part of the season (middle of June). Of vertebrates only two *Eremids* and one *Trigonocephalus hydrus* were found. Shankh-mardan and Jordan, on the contrary, gave a rich crop of insects, and M. Grzimaïlo remained there for ten days. On a rich Alpine pasturage, Artcha-bash, where Kirghizes are in the habit of staying, he found very rich zoological materials. The collections were enriched with a great number of rare species, such as *Pol. tamerlana*, *Colias eogene*, *Arctia erschoffi*, *Hol. jagorum*, which are common almost exclusively to the Himalayas and the South-West Thian-Shan, as also by several new species. On the snow-covered plateaux interesting specimens were found, and among them the *Megaloperdix nigelie* and the *Arctomys caudatus*. On the upper Kok-su, extending to a height of 12,000 feet, M. Grzimaïlo found a number of species which he did not see either before or afterwards during his journey, especially with regard to Lepidoptera. Vertebrates are few at this height; they were represented by the *Arctomys caudatus*, the eagle (*A. fulva*), one species of *Falco*, the *Fringilla graculus*, the *Pyrrhocorax alpinus*?, *Pica*, *Caccabis huckar*, *Megaloperdix*, and *Columba*. On the pass itself the holes of the *Arctomys caudatus* are seen everywhere, as also holes of some *Arvicola*. The Lepidoptera are richly represented at that part of the summer, especially the two genera *Colias* and *Parnassius*. On the Djekaindy Pass it was the same; the *Lycæna* were very numerous, so that on the space of 3 metres the author found fifteen species of them, of which three were unknown to him. Without mentioning localities of minor interest, the plateau between the Kara-su and the Aram is worthy of notice for the brilliant collections of Lepidoptera which were made there. One *Lacerta* was found at a height of 11,000 feet, a species of *Elaphis*, the *Canis melanotus*, the *Lepus lehmanni*, the *Ovis polii*; of birds, the Falconidæ were most usual; also the *Upupa epops*, the *Cuculus canorum*, species of *Columba*, the *Orthyxion coturnix*, *Caccabis huckar*, *Corvus corax*, and many others, this last reaching the highest parts of the region. Another find of great interest must be mentioned. The late Mr. Fedchenko had already caught one female Lepidopteron, which was determined by M. Erschoff as *Colias nastes*. This species having been found formerly only in Labrador and Northern Lapland, the determination remained doubtful, the individual having been but a female. M. Grzimaïlo has happened to catch a number of both males and females, which really proved both to belong to *C. nastes*. It remains now to explain the strange extension of this species.

SCIENTIFIC SERIALS

Rendiconto della R. Accademia delle Scienze di Bologna, 1884-5.—On the geometrical construction of the central axis in a given system of forces, by Prof. F. P. Ruffini.—A fresh contribution to clinico-experimental studies, showing the depressing action of ipecacuanha administered in large doses in pulmonary affections, by Prof. F. Verardini.—On the velocity of the polarised rays in a body endowed with rotatory motion, by Prof. Augusto Righi.—On the physico-pathology of the suprarenal capsules, by Prof. Guido Tizzoni.—On *Perineo melus*, a new genus of parasite observed in the pig, by Prof. Cesare Taruffi.—On the antimoniates of bismuth, by Dr. Alfredo Cavazzi.—Action of gaseous phosphated hydrogen on the trichloride of gold dissolved in ether, in alcohol, and in water, by Dr. A. Cavazzi.—On conjugated conic sections, by Prof. Virginia Retali.—Some researches on the so-called syntomatic carbuncle in cattle, by Prof. Alfredo Gotti.—Observations on Jacobson's organ and on Stenson's duct in the camel, by Dr. Francesco Peli.—On the central termination of the optical nerves in mammals, by Prof. Giuseppe Bellonci.—On the paraboloid surfaces in the selliform rhombohedrals of dolomite and other anhydrous carbonates, by Prof. Luigi Bombicci.—Some general observations on the systems of functions, by Prof. Salvatore Pincherle.—On a monstrous fœtus requiring the operation of embryotomy for its delivery, by Dr. Cesare Belluzzi.—On the question of sex in *Tolyposporium cocconi*, by Dr. Fausto Morini.—On the fossil remains of *Dioplon* and *Mesoplon* occurring in the Upper Tertiary formations in Italy, by Prof. Giovanni Capellini.—Forensic experiments in traumatology with firearms, by Dr. Giuseppe Ravaglia.—Contributions to the chemical study of intestinal perforation in typhoid fever, by Prof. Giovanni Brugnoli.—On the mode of genesis of a polar globule in the ovarium of certain mammals, by Prof. Giuseppe Bellonci.—A systematic enumeration of the funguses in the province of Bologna, by Dr. Fausto Marini.—On the thermal emissive power of electric sparks, by Prof. Emilio Villari.—On the use of curvilinear coordinates in the theory of the potential and of elasticity, by Prof. Eugenio Beltrami.—An analytic method of determining the equation of time, by Prof. Antonio Saporetto.

SOCIETIES AND ACADEMIES BERLIN

Physiological Society, June 19.—Dr. J. Munk gave a brief sketch of the different views put forth respecting the formation of fat in the animal body, and then gave a short account of the now almost universally accepted view of Voit, who, on the basis of his very numerous experiments, laid down the doctrine that the fat in the animal body proceeded either from the alimentary fat, or, when this was not sufficient, from the albumen, which on its decomposition yielded products that by synthesis became transformed into fat, while the carbohydrates never yielded material towards the formation of fat in the animal body. Opposition to this doctrine was raised on the side only of agricultural chemists, who, by experiments on swine and geese produced direct demonstration that the deposition of fat was considerably increased by feeding with carbohydrates. In consequence of these experiments Prof. Voit admitted that omnivorous and herbivorous animals might in certain circumstances form fat out of carbohydrates; such, however, he maintained, was never the case with carnivorous animals and man; in them all fat was derived from the alimentary fat and the decomposition of albumen, both in his own experiments and in all hitherto published, and the fat was seen to be derivable from these two sources alone, even though only 12 per cent. of the decomposed albumen were taken for the formation of fat, and much more if, according to the theoretic calculations of Herr Henneberg, it was assumed that as much as 51 per cent. of the decomposed albumen might be utilised towards the formation of fat. Seeing now that Prof. Voit admitted that, in the case of omnivorous and herbivorous animals fat was produced from carbohydrates, the speaker set himself the task of establishing experimental conditions under which fat might be formed from carbohydrates in the case, likewise, of carnivorous animals. For these experiments he selected a dog, completely impoverished of it all fat by means of long fasting, and then gave it an aliment very rich in carbohydrates. The animal required to be young, or otherwise the loss of fat by fasting could not be complete, and if it were desired to obtain certainty respecting the attainment of perfect