

Scientific American Supplement, No. 415, December 15, 1883 eBook

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THE GERMAN NATIONAL MONUMENT.—WAR AND PEACE.

In our *supplement* No. 412 we gave several engravings and a full description of the colossal German National monument “Germania,” lately unveiled on the Niederwald slope of the Rhine. We now present, as beautiful suggestions in art, engravings of the two statues, War and Peace, which adorn the corners of the monumental facade. These figures are about twenty feet high. The statue of War represents an allegorical character, partly Mercury, partly mediaeval knight, with trumpet in one hand, sword in the other. The statue of Peace represents a mild and modest maiden, holding out an olive branch in one hand and the full horn of peaceful blessings in the other. Between the two statues is a magnificent group in relief representing the “Watch on the Rhine.” Here the Emperor William appears in the center, on horseback, surrounded by a noble group of kings, princes, knights, warriors, commanders, and statesmen, who, by word or deed or counsel, helped to found the empire—an Elgin marble, so to speak, of the German nation.

[Illustration: *War. The German national monument. Peace.*]

* * * * *

A writer in the London *Lancet* ridicules a habit of being in great haste and terribly pressed for time which is common among all classes of commercial men, and argues that in most cases there is not the least cause for it, and that it is done to convey a notion of the tremendous volume of business which almost overwhelms the house. The writer further says that, when developed into a confirmed habit, it is fertile in provoking nervous maladies.

* * * * *

THE ART ASPECTS OF MODERN DRESS.

At a recent conversazione of the London Literary and Artistic Society, Mr. Sellon read a paper upon this subject. Having expressed his belief that mere considerations of health would never dethrone fashion, the lecturer said he should endeavor to show on art principles how those who were open to conviction could have all the variety Fashion promised, together with far greater elegance than that goddess could bestow, while health received the fullest attention. Two excellent societies, worthy of encouragement up to a certain point, had been showing us the folly and wickedness of fashionable dress—dress which deformed the body, crippled the feet, confined the waist, exposed the chest, loaded the limbs, and even enslaved the understanding. But these societies had been more successful in pulling down than in building up, and blinded with excess



of zeal were hurrying us onward to a goal which might or might not be the acme of sanitative dress, but was certainly the zero of artistic excellence. The cause of this was not far to seek. We were inventing a new science,



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that of dress, and were without rules to guide us. So long as ladies had to choose between Paris fashions and those of Piccadilly Hall, they would, he felt sure, choose the former. Let it be shown that the substitute was both sanitary and beautiful, capable of an infinite variety in color and in form—in colors and forms which never violated art principle, and in which the wearer, and not some Paris liner, could exercise her taste, and the day would have been gained. This was the task he had set himself to formulate, and so doing he should divide his subject in two—Color and Form.

In color it was desirable to distinguish carefully between the meaning of shade, tint, and hue. It was amazing that a cultured nation like the English should be so generally ignorant of the laws of color harmony. We were nicely critical of music, yet in color were constantly committing the gravest solecisms. He did not think there were seventeen interiors in London that the educated eye could wander over without pain. Yet what knowledge was so useful? We were not competent to buy a picture, choose a dress, or furnish a house without a knowledge of color harmony, to say nothing of the facility such knowledge gave in all kinds of painting on porcelain, art needlework, and a hundred occupations.

An important consideration in choosing colors for dress was the effect they would have in juxtaposition. Primary colors should be worn in dark shades; dark red and dark yellow, or as it was commonly called, olive green, went well together; but a dress of full red or yellow would be painful to behold. The rule for full primaries was, employ them sparingly, and contrast them only with black or gray. He might notice in passing that when people dressed in gray or black the entire dress was usually of the one color unrelieved. Yet here they had a background that would lend beauty to any color placed upon it.

Another safe rule was never to place together colors differing widely in hue. The eye experienced a difficulty in accommodating itself to sudden changes, and a species of color discord was the consequence. But if the colors, even though primaries, were of some very dark or very light shade, they become harmonious. All very dark shades of color went well with black and with each other, and all very light shades went well with white and each other.

A much-vexed question with ladies was, "What will suit my complexion?" The generally received opinion was that the complexion was pink, either light or dark, and colors were chosen accordingly, working dire confusion. But no one living ever had a pink complexion unless a painted one. The dolls in the Lowther Arcade were pink, and their pink dresses were in harmony. No natural complexion whatever was improved by pink; but gray would go with any. The tendency of gray was to give prominence to the dominant hue in the complexion. When an artist wished to produce flesh color he mixed white, light

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red, yellow ocher, and terra vert. The skin of a fair person was a gray light red, tinged with green; the color that would brighten and intensify it most was a gray light sea green, tinged with pink—in other words, its complementary. A color always subtracted any similar color that might exist in combination near it. Thus red beside orange altered it to yellow; blue beside pink altered it to cerise. Hence, if a person was so unfortunate as to have a muddy complexion, the worst color they could wear would be their own complexion's complementary—the best would be mud color, for it would clear their complexion.

Passing on to the consideration of form in costume, the lecturer urged that the proper function of dress was to drape the human figure without disguising or burlesquing it. An illustration of Miss Mary Anderson, attired in a Greek dress as Parthenia, was exhibited, and the lecturer observed that while the dress once worn by Greek women was unequaled for elegance, Greek women were not in the habit of tying their skirts in knots round the knees, and the nervous pose of the toes suggested a more habitual acquaintance with shoes and stockings.

An enlargement from a drawing by Walter Crane was shown as illustrating the principles of artistic and natural costume—costume which permitted the waist to be the normal size, and allowed the drapery to fall in natural folds—costume which knew nothing of pleats and flounces, stays and “improvers”—costume which was very symbolization and embodiment of womanly grace and modesty.

A life-sized enlargement of a fashion plate from *Myra's Journal*, dated June 1, 1882, was next shown. The circumference of the waist was but $12\frac{3}{4}$ in., involving an utter exclusion of the liver from that part of the organization, and the attitude was worthy of a costume which was the *ne plus ultra* of formal ugliness.

Having shown another and equally unbecoming costume, selected from a recent issue by an Oxford Street firm, the lecturer asked, Why did women think small waists beautiful? Was it because big-waisted women were so frequently fat and forty, old and ugly? A young girl had no waist, and did not need stays. As the figure matured the hips developed, and it was this development which formed the waist. The slightest artificial compression of the waist destroyed the line of beauty. Therefore, the grown woman should never wear stays, and, since they tended to weaken the muscles of the back, the aged and weak should not adopt them. A waist really too large was less ungraceful than a waist too small. Dress was designed partly for warmth and partly for adornment. As the uses were distinct, the garments should be so. A close-fitting inner garment should supply all requisite warmth, and the outer dress should be as thin as possible, that it might drape itself into natural folds. Velvet, from its texture, was ill adapted for this. When worn, it should be in close fitting garments, and in dark colors only. It was most effective when black.

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Turning for a few moments, in conclusion, to men's attire, the lecturer suggested that the ill-success of dress reformers hitherto had been the too-radical changes they sought to introduce. We could be artistic without being archaic. Most men were satisfied without clothes fairly in fashion, a tolerable fit, and any unobtrusive color their tailor pleased. He would suggest that any reformation should begin with color.

* * * * *

ARTISANS' DWELLINGS, HORNSEY.

The erection of artisans' dwellings is certainly a prominent feature in the progress of building in the metropolis, and speculative builders who work on a smaller scale would do well not to ignore the fact. The Artisans, Laborers, and General Dwellings Company (Limited) has been conspicuously successful in rearing large blocks of dwellings for artisans, clerks, and others whose means necessitates the renting of a convenient house at as low a rental as it is possible to find it. We give an illustration of a terrace of first-class houses built by the above company, who deserve great praise for the spirited and liberal manner in which they are going to work on this the third of their London estates—the Noel Park Estate, at Hornsey. On the estates at Shaftesbury and Queen's Parks they have already built about three thousand houses, employing therein a capital of considerably over a million sterling, while at Noel Park they are rapidly covering an estate of one hundred acres, which will contain, when completed, no less than two thousand six hundred houses, to be let at weekly rentals varying from 6s. to 11s. 6d., rates and taxes all included. The object has been to provide separate cottages, each in itself complete, and in so doing they have not made any marked departure from the ordinary type of suburban terrace plan, but adopting this as most favorable to economy, have added many improvements, including sanitary appliances of the latest and most approved type.

The most important entrance to Noel Park is by Gladstone Avenue, a road 60 ft. wide leading from the Green Lanes to the center of the estate. On either side of this road the houses are set back 15 ft., in front of which, along the edge of the pavement, trees of a suitable growth are being planted, as also on all other roads on the estate. About the center of Gladstone Avenue an oval space has been reserved as a site for a church, and a space of five acres in another portion of the estate has been set apart to be laid out as a recreation ground, should the development of the estate warrant such an outlay. The remaining streets are from 40 ft. to 50 ft. in width, clear of the garden space in front of the houses. Shops will be erected as may be required.

[Illustration: *Suggestions in architecture.—A row of comfortable dwellings.*]

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The drainage of the estate has been arranged on the dual system, the surface water being kept separate from the sewage drains. Nowhere have these drains been carried through the houses, but they are taken directly into drains at the back, having specially ventilated manholes and being brought through at the ends of terraces into the road sewers; the ventilating openings in the roads have been converted into inlet ventilators by placing upcast shafts at short intervals, discharging above the houses. This system of ventilation was adopted on the recommendation of Mr. W.A. De Pape, the engineer and surveyor to the Tottenham Local Board.

All the houses are constructed with a layer of concrete over the whole area of the site, and a portion of the garden at back. Every room is specially ventilated, and all party walls are hollow in order to prevent the passage of sound. A constant water supply is laid on, there being no cisterns but those to the water-waste preventers to closets. All water pipes discharge over open trapped gullies outside.

The materials used are red and yellow bricks, with terracotta sills, the roofs being slated over the greater part, and for the purpose of forming an agreeable relief, the end houses, and in some cases the central houses, have red tile roofs, the roofs over porches being similarly treated. The houses are simply but effectively designed, and the general appearance of the finished portion of the estate is bright and cheerful. All end houses of terraces have been specially treated, and in some cases having rather more accommodation than houses immediately adjoining, a slightly increased rental is required. There are five different classes of houses. The first class houses (which we illustrate this week) are built on plats having 16 ft. frontage by 85 ft. depth, and containing eight rooms, consisting of two sitting rooms, kitchen, scullery, with washing copper, coal cellar, larder, and water-closet on ground floor, and four bedrooms over. The water-closet is entered from the outside, but in many first-class houses another water-closet has been provided on the first floor, and one room on this floor is provided with a small range, so that if two families live in the one house they will be entirely separated. The rental of these houses is about 11s. to 11s. 6d. per week. Mr. Rowland Plumbe, F.R.I.B.A., of 13 Fitzroy Square, W., is the architect.—*Building and Engineering Times*.

* * * * *

ENLARGING ON ARGENTIC PAPER AND OPALS.

By A. Goodall.

[Footnote: Read before the Dundee and East of Scotland Photographic Association.]

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The process of making gelatino bromide of silver prints or enlargements on paper or opal has been before the public for two or three years now, and cannot be called new; but still it is neither so well known nor understood as such a facile and easy process deserves to be, and I may just say here that after a pretty extensive experience in the working of it I believe there is no other enlarging process capable of giving better results than can be got by this process when properly understood and wrought, as the results that can be got by it are certainly equal to those obtainable by any other method, while the ease and rapidity with which enlarged pictures can be made by it place it decidedly ahead of any other method. I propose to show you how I make a gelatino bromide enlargement on opal.

[Mr. Goodall then proceeded to make an enlargement on a 12 by 10 opal, using a sciopicon burning paraffin; after an exposure for two and a-half minutes the developer was applied, and a brilliant opal was the result.]

We now come to the paper process, and most effective enlargements can be made by it also; indeed, as a basis for coloring, nothing could well be better. Artists all over the country have told me that after a few trials they prefer it to anything else, while excellent and effective plain enlargements are easily made by it if only carefully handled. A very good enlargement is made by vignetting the picture, as I have just done, with the opal, and then squeezing it down on a clean glass, and afterward framing it with another glass in front, when it will have the appearance almost equal to an opal. To make sure of the picture adhering to the glass, however, and at the same time to give greater brilliancy, it is better to flow the glass with a 10 or 15 grain solution of clear gelatine before squeezing it down. The one fault or shortcoming of the plain argentic paper is the dullness of the surface when dry, and this certainly makes it unsuitable for small work, such as the rapid production of cartes or proofs from negatives wanted in a hurry; the tone of an argentic print is also spoken of sometimes as being objectionable; but my impression is, that it is not so much the tone as the want of brilliancy that is the fault there, and if once the public were accustomed to the tones of argentine paper, they might possibly like them twice as well as the purples and browns with which they are familiar, provided they had the depth and gloss of a silver print; and some time ago, acting on a suggestion made by the editor of the *Photographic News*, I set about trying to produce this result by enameling the paper with a barium emulsion previous to coating it with the gelatinous bromide of silver. My experiments were successful, and we now prepare an enamel argentic paper on which the prints stand out with brilliancy equal to those on albumenized paper. I here show you specimens of boudoirs and panels—pictures enlarged from C.D.V.—negatives on this enamel argentic.

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[Mr. Goodall then passed round several enlargements from landscape and portrait negatives, which it would have been difficult to distinguish from prints on double albumenized paper.]

I have already spoken of the great ease and facility with which an argentic enlargement may be made as compared with a collodion transfer, for instance; but there is another and more important point to be considered between the two, and that is, their durability and permanence. Now with regard to a collodion transfer, unless most particular care be taken in the washing of it (and those who have made them will well know what a delicate, not to say difficult, job it is to get them thoroughly freed from the hypo, and at the same time preserve the film intact), there is no permanence in a collodion transfer, and that practically in nine cases out of ten they have the elements of decay in them from the first day of their existence. I know, at least in Glasgow, where an enormous business has been done within the last few years by certain firms in the club picture trade (the club picture being a collodion transfer tinted in oil or varnish colors), there are literally thousands of pictures for which thirty shillings or more has been paid, and of which the bare frame is all that remains at the present day; the gilt of the frames has vanished, and the picture in disgust, perhaps, has followed it. In short, I believe a collodion transfer cannot be made even comparatively permanent, unless an amount of care be taken in the making of it which is neither compatible nor consistent with the popular price and extensive output. How now stands the case with an argentic enlargement? Of course it may be said that there is scarcely time yet to make a fair comparison—that the argentic enlargements are still only on their trial.

I will give you my own experience. I mentioned at the outset that seven or eight years ago I had tried Kennet's pellicle and failed, but got one or two results which I retained as curiosities till only a month or two ago; but up to that time I cannot say they had faded in the least, and I have here a specimen made three years ago, which I have purposely subjected to very severe treatment. It has been exposed without any protection to the light and damp and all the other noxious influences of a Glasgow atmosphere, and although certainly tarnished, I think you will find that it has not faded; the whites are dirty, but the blacks have lost nothing of their original strength. I here show you the picture referred to, a 12 by 10 enlargement on artist's canvas, and may here state, in short, that my whole experience of argentic enlargements leads me to the conclusion that, setting aside every other quality, they are the most permanent pictures that have ever been produced. Chromotypes and other carbon pictures have been called permanent, but their permanence depends upon the nature of the pigment employed, and associated with the chromated



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gelatine in which they are produced, most of pigments used, and all of the prettiest ones, being unable to withstand the bleaching action of the light for more than a few weeks. Carbon pictures are therefore only permanent according to the degree in which the coloring matter employed is capable of resisting the decolorizing action of light. But there is no pigment in an argentic print, nothing but the silver reduced by the developer after the action of light; and that has been shown by, I think, Captain Abney, to be of a very stable and not easily decomposed nature; while if the pictures are passed through a solution of alum after washing and fixing, the gelatine also is so acted upon as to be rendered in a great degree impervious to the action of damp, and the pictures are then somewhat similar to carbon pictures without carbon.

I may now say a few words on the defects and failures sometimes met with in working this process; and first in regard to the yellowing of the whites. I hear frequent complaints of this want of purity in the whites, especially in vignettted enlargements, and I believe that this almost always arises from one or other of the two following causes:

First. An excess of the ferrous salt in the ferrous oxalate developer; and when this is the case, the yellow compound salt is more in suspension than solution, and in the course of development it is deposited upon, and at the same time formed in, the gelatinous film.

The proportions of saturated solution of oxalate to saturated solution of iron, to form the oxalate of iron developer, that has been recommended by the highest and almost only scientific authority on the subject—Dr. Eder—are from 4 to 6 parts of potassic oxalate to 1 part of ferrous sulphate.

Now while these proportions may be the best for the development of a negative, they are not, according to my experience, the best for gelatine bromide positive enlargements; I find, indeed, that potassic oxalate should not have more than one-eighth of the ferrous sulphate solution added to it, otherwise it will not hold in proper solution for any length of time the compound salt formed when the two are mixed.

The other cause is the fixing bath. This, for opals and vignettted enlargements especially, should always be fresh and pretty strong, so that the picture will clear rapidly before any deposit has time to take place, as it will be observed that very shortly after even one iron developed print has been fixed in it a deposit of some kind begins to take place, so that although it may be used a number of times for fixing prints that are meant to be colored afterward it is best to take a small quantity of fresh hypo for every enlargement meant to be finished in black and white. The proportions I use are 8 ounces to the pint of water. Almost the only other complaints I now hear are traceable to over-exposure or lack of intelligent cleanliness in the handling of the paper. The



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operator, after having been dabbling for some time in hypo, or pyro, or silver solution, gives his hands a wipe on the focusing cloth, and straightway sets about making an enlargement, ending up by blessing the manufacturer who sent him paper full of black stains and smears. Argentic paper is capable of yielding excellent enlargements, but it must be intelligently exposed, intelligently developed, and cleanly and carefully handled.

* * * * *

THE MANUFACTURE AND CHARACTERISTICS OF PHOTOGRAPHIC LENSES.

At a recent meeting of the London and Provincial Photographic Association Mr. J. Traill Taylor, formerly of New York, commenced his lecture by referring to the functions of lenses, and by describing the method by which the necessary curves were computed in order to obtain a definite focal length. The varieties of optical glass were next discussed, and specimens (both in the rough and partly shaped state) were handed round for examination. The defects frequently met with in glass, such as striae and tears, were then treated upon; specimens of lenses defective from this cause were submitted to inspection, and the mode of searching for such flaws described. Tools for grinding and polishing lenses of various curvatures were exhibited, together with a collection of glass disks obtained from the factory of Messrs. Ross & Co., and in various stages of manufacture—from the first rough slab to the surface of highest polish. Details of polishing and edging were gone into, and a series of the various grades of emery used in the processes was shown. The lecturer then, by means of diagrams which he placed upon the blackboard, showed the forms of various makes of photographic lenses, and explained the influence of particular constructions in producing certain results; positive and negative spherical aberration, and the manner in which they are made to balance each other, was also described by the aid of diagrams, as was also chromatic aberration. He next spoke of the question of optical center of lenses, and said that that was not, as had been hitherto generally supposed, the true place from which to measure the focus of a lens or combination. This place was a point very near the optical center, and was known as the "Gauss" point, from the name of the eminent German mathematician who had investigated and made known its properties, the knowledge of which was of the greatest importance in the construction of lenses. A diagram was drawn to show the manner of ascertaining the two Gauss points of a bi-convex lens, and a sheet exhibited in which the various kinds of lenses with their optical centers and Gauss points were shown. For this drawing he (Mr. Taylor) said he was indebted to Dr. Hugo Schroeder, now with the firm of Ross & Co. The lecturer congratulated the newly-proposed member of the Society, Mr. John Stuart, for his enterprise in securing for this country



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a man of such profound acquirements. The subject of distortion was next treated of, and the manner in which the idea of a non distorting doublet could be evolved from a single bi-convex lens by division into two plano-convex lenses with a central diaphragm was shown. The influence of density of glass was illustrated by a description of the doublet of Steinheil, the parent of the large family of rapid doublets now known under various names. The effect of thickness of lenses was shown by a diagram of the ingenious method of Mr. F. Wenham, who had long ago by this means corrected spherical aberration in microscopic objective. The construction of portrait lenses was next gone into, the influence of the negative element of the back lens being especially noted. A method was then referred to of making a rapid portrait lens cover a very large angle by pivoting at its optical center and traversing the plate in the manner of the pantoscopic camera. The lecturer concluded by requesting a careful examination of the valuable exhibits upon the table, kindly lent for the occasion by Messrs. Ross & Co.

* * * * *

IMPROVED DEVELOPERS FOR GELATINE PLATES.

By Dr. Eder.

We are indebted to Chas. Ehrmann, Esq., for the improved formulas given below as translated by him for the *Photographic Times*.

Dr. Eder has for a considerable time directed especial attention to the soda and potash developers, either of which seems to offer certain advantages over the ammoniacal pyrogallol. This advantage becomes particularly apparent with emulsions prepared with ammonia, which frequently show with ammoniacal developer green or red fog, or a fog of clayish color by reflected, and of pale purple by transmitted light. Ferrous oxalate works quite well with plates of that kind; so do soda and potassa developers.

For soda developers, Eder uses a solution of 10 parts of pure crystallized soda in 100 parts of water. For use, 100 c.c. of this solution are mixed with 6 c.c. of a pyrogallic solution of 1:10, without the addition of any bromide.

More pleasant to work with is Dr. Stolze's potassa developer. No. 1: Water, 200 c.c.; chem. pure potassium carbonate, 90 gr.; sodium sulphite, 25 gr. No. 2: Water 100 c.c.; citric, 11/2 gr.; sodium sulphite, 25 gr.; pyrogallol., 12 gr. Solution No. 2 is for its better keeping qualities preferable to Dr. Stolze's solution.[A] The solutions when in well stoppered bottles keep well for some time. To develop, mix 100 c.c. of water with 40 min. of No. 1 and 50 min. of No. 2. The picture appears quickly and more vigorously than with iron oxalate. If it is desirable to decrease the density of the negatives, double



the quantity of water. The negatives have a greenish brown to olive-green tone. A very fine grayish-black can be obtained by using a strong alum bath between developing and fixing. The same bath after fixing does not act as effectual in producing the desired tone. A bath of equal volumes of saturated solutions of alum and ferrous sulphate gives the negative a deep olive-brown color and an extraordinary intensity, which excludes all possible necessities of an after intensification.

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[Footnote A: 100 c.c. water; 10 c.c. alcohol; 10 gr. pyrogallol; 1 gr. salicylic acid.]

The sensitiveness with this developer is at least equal to that when iron developer is used, frequently even greater.

The addition of bromides is superfluous, sometimes injurious. Bromides in quantities, as added to ammoniacal pyro, would reduce the sensitiveness to 1/10 or 1/20; will even retard the developing power almost entirely.

Must a restrainer be resorted to, 1 to 3 min. of a 1:10 solution of potassium bromide is quite sufficient.

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THE PREPARATION OF LARD FOR USE IN PHARMACY.

[Footnote: Read at an evening meeting of the Pharmaceutical Society of Great Britain, November 7, 1883.]

By Professor *Redwood*.

I have read with much interest the paper on "Ointment Bases," communicated by Mr. Willmott to the Pharmaceutical Conference at its recent meeting, but the part of the subject which has more particularly attracted my attention is that which relates to prepared lard. Reference is made by Mr. Willmott to lard prepared in different ways, and it appears from the results of his experiments that when made according to the process of the British Pharmacopoeia it does not keep free from rancidity for so long a time as some of the samples do which have been otherwise prepared. The general tendency of the discussion, as far as related to this part of the subject, seems to have been also in the same direction; but neither in the paper nor in the discussion was the question of the best mode of preparing lard for use in pharmacy so specially referred to or fully discussed as I think it deserves to be.

When, in 1860, Mr. Hills, at a meeting of the Pharmaceutical Society, suggested a process for the preparation of lard, which consisted in removing from the "flare" all matter soluble in water, by first thoroughly washing it in a stream of cold water after breaking up the tissues and afterward melting and straining the fat at a moderate heat, this method of operating seemed to be generally approved. It was adopted by men largely engaged in "rendering" fatty substances for use in pharmacy and for other purposes for which the fat was required to be as free as possible from flavor and not unduly subject to become rancid. It became the process of the British Pharmacopoeia in 1868. In 1869 it formed the basis of a process, which was patented in Paris and this



country by Hippolite Mege, for the production of a fat free from taste and odor, and suitable for dietetic use as a substitute for butter. Mege's process consists in passing the fat between revolving rollers, together with a stream of water, and then melting at "animal heat." This process has been used abroad in the production of the fatty substance called oleomargarine.

But while there have been advocates for this process, of whom I have been one, opinions have been now and then expressed to the effect that the washing of the flare before melting the fat was rather hurtful than beneficial. I have reason to believe that this opinion has been gaining ground among those who have carefully inquired into the properties of the products obtained by the various methods which have been suggested for obtaining animal fat in its greatest state of purity.

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I have had occasion during the last two or three years to make many experiments on the rendering and purification of animal fat, and at the same time have been brought into communication with manufacturers of oleomargarine on the large scale; the result of which experience has been that I have lost faith in the efficacy of the Pharmacopeia process. I have found that in the method now generally adopted by manufacturers of oleomargarine, which is produced in immense quantities, the use of water, for washing the fat before melting it, is not only omitted but specially avoided. The parts of the process to which most importance is attached are: First, the selection of fresh and perfectly sweet natural fat, which is hung up and freely exposed to air and light. It thus becomes dried and freed from an odor which is present in the freshly slaughtered carcass. It is then carefully examined, and adhering portions of flesh or membrane as far as possible removed; after which it is cut up and passed through a machine in which it is mashed so as to completely break up the membraneous vesicles in which the fat is inclosed. The magma thus produced is put into a deep jacketed pan heated by warm water, and the fat is melted at a temperature not exceeding 130 deg.F.

If the flare has been very effectually mashed, the fat may be easily melted away from the membraneous matter at 120 deg.F., or even below that, and no further continuance of the heat is required beyond what is necessary for effecting a separation of the melted fat from the membraneous or other suspended matter. Complete separation of all suspended matter is obviously important, and therefore nitration seems desirable, where practicable; which however is not on the large scale.

My experiments tend to indicate that the process just described is that best adapted for the preparation of lard for use in pharmacy. There is, however, a point connected with this or any other method of preparing lard which is deserving of more attention than it has, I believe, usually received, and that is, the source from which the flare has been derived. Everybody knows how greatly the quality of pork depends upon the manner in which the pig has been fed, and this applies to the fat as well as other parts of the animal. Some time ago I had some pork submitted to me for the expression of opinion upon it, which had a decided fishy flavor, both in taste and smell. This flavor was present in every part, fat and lean, and it is obvious that lard prepared from that fat would not be fit for use in pharmacy. The pig had been prescribed a fish diet. Barley meal would, no doubt, have produced a better variety of lard.

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ANTI-CORROSION PAINT.

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The *Neueste Erfindung* describes an anti-corrosion paint for iron. It states that if 10 per cent. of burnt magnesia, or even baryta, or strontia, is mixed (cold) with ordinary linseed-oil paint, and then enough mineral oil to envelop the alkaline earth, the free acid of the paint will be neutralized, while the iron will be protected by the permanent alkaline action of the paint. Iron to be buried in damp earth may be painted with a mixture of 100 parts of resin (colophony), 25 parts of gutta-percha, and 50 parts of paraffin, to which 20 parts of magnesia and some mineral oil have been added.

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CARBON IN STEEL.

At a recent meeting of the Chemical Society, London, a paper was read entitled "Notes on the Condition in which Carbon exists in Steel," by Sir F.A. Abel, C.B., and W.H. Deering.

Two series of experiments were made. In the first series disks of steel 2.5 inches in diameter and 0.01 inch thick were employed. They were all cut from the same strip of metal, but some were "cold-rolled," some "annealed," and some "hardened." The total carbon was found to be: "cold-rolled," 1.108 per cent.; hardened, 1.128 per cent.; and annealed, 0.924 and 0.860 per cent. Some of the disks were submitted to the action of an oxidizing solution consisting of a cold saturated solution of potassium bichromate with 5 per cent. by volume of pure concentrated sulphuric acid. In all cases a blackish magnetic residue was left undissolved. These residues, calculated upon 100 parts of the disks employed, had the following compositions: "Cold-rolled" carbon, 1.039 per cent.; iron, 5.871. Annealed, C, 0.83 per cent.; Fe, 4.74 per cent. Hardened, C, 0.178 per cent.; Fe, 0.70 per cent. So that by treatment with chromic acid in the cold nearly the whole of the carbon remains undissolved with the cold-rolled and annealed disks, but only about one-sixth of the total carbon is left undissolved in the case of the hardened disk. The authors then give a *resume* of previous work on the subject. In the second part they have investigated the action of bichromate solutions of various strengths on thin sheet-steel, about 0.098 inch thick, which was cold-rolled and contained: Carbon, 1.144 per cent.; silica, 0.166 per cent.; manganese, 0.104 per cent. Four solutions were used. The first contained about 10 per cent. of bichromate and 9 per cent. of H₂SO₄ by weight; the second was eight-tenths as strong, the third about half as strong, the fourth about one and a half times as strong. In all cases the amount of solution employed was considerably in excess of the amount required to dissolve the steel used. A residue was obtained as before. With solution 1, the residue contained, C, 1.021; sol. 2, C, 0.969; sol. 3, C 1.049 the atomic ratio of iron to carbon was Fe 2.694: C, 1; Fe, 2.65: C, 1; Fe), 2.867 C, 1): sol. 4. C, 0.266 per 100 of steel. The authors conclude that the carbon in cold rolled steel exists not simply diffused mechanically through the mass of steel but in the form of an iron carbide, Fe₃C, a definite product, capable of resisting the action of an oxidizing solution (if the latter is not

too strong), which exerts a rapid solvent action upon the iron through which the carbide is distributed.



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APPARATUS FOR EXTRACTING STARCH FROM POTATOES.

In the apparatus of Mr. Angele, of Berlin, shown in the annexed cuts (Figs. 1 and 2), the potatoes, after being cleaned in the washer, C, slide through the chute, v, into a rasp, D, which reduces them to a fine pulp under the action of a continuous current of water led in by the pipe, d. The liquid pulp flows into the iron reservoir, B, from whence a pump, P, forces it through the pipe, w, to a sieve, g, which is suspended by four bars and has a backward and forward motion. By means of a rose, c, water is sprinkled over the entire surface of the sieve and separates the fecula from the fibrous matter. The water, charged with fine particles of fecula, and forming a sort of milk, flows through the tube, z, into the lower part, N, of the washing apparatus, F, while the pulp runs over the sieve and falls into the grinding-mill, H. This latter divides all those cellular portions of the fecula that have not been opened by the rasp, and allows them to run, through the tube, h, into the washing apparatus, F, where the fecula is completely separated from woody fibers. The fluid pulp is carried by means of a helix, i, to a revolving perforated drum at e. From this, the milky starch flows into the jacket, N, while the pulp (ligneous fibers) makes its exit from the apparatus through the aperture, n, and falls into the reservoir, o.

[Illustration: ANGELE'S *potato-starch apparatus*.]

The liquid from the jacket, N, passes to a refining sieve, K, which, like the one before mentioned, has a backward and forward motion, and which is covered with very fine silk gauze in order to separate the very finest impurities from the milky starch. The refined liquid then flows into the reservoir, m, and the impure mass of sediment runs into the pulp-reservoir, o. The pump, l, forces the milky liquid from the reservoir, m, to the settling back, while the pulp is forced by a pump, u, from the receptacle, o, into a large pulp-reservoir.

The water necessary for the manufacture is forced by the pump, a, into the reservoir, W, from whence it flows, through the pipes, r, into the different machines. All the apparatus are set in motion by two shaftings, q. The principal shaft makes two hundred revolutions per minute, but the velocity of that of the pumps is but fifty revolutions.—*Polytech. Journ., and Bull. Musee de l'Indust.*

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A SIMPLE APPARATUS FOR DESCRIBING ELLIPSES.

By Prof. E.J. Hallock.



A very simple apparatus for describing an oval or ellipse may be constructed by any apprentice or school boy as follows: Procure a straight piece of wood about $\frac{1}{4}$ inch wide by $\frac{1}{8}$ inch thick and 13 inches long. Beginning $\frac{1}{2}$ inch from the end, bore a row of small holes only large enough for a darning needle to pass through and half an inch apart. Mark the first one (at A) 0, the third 1, the fifth 2, and so on to 12, so that the numbers represent the distance from O in inches. A small slit may be made in the end of the ruler or strip of wood near A, but a better plan is to attach a small clip on one side.



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[Illustration: *Ellipse instrument.*]

Next procure a strong piece of linen thread about four feet long; pass it through the eye of a coarse needle, wax and twist it until it forms a single cord. Pass the needle *upward* through the hole marked O, and tie a knot in the end of the thread to prevent its slipping through. The apparatus is now ready for immediate use. It only remains to set it to the size of the oval desired.

Suppose it is required to describe an ellipse the longer diameter of which is 8 inches, and the distance between the foci 5 inches. Insert a pin or small tack loosely in the hole between 6 and 7, which is distant 6-1/2 inches from O. Pass the needle through hole 5, allowing the thread to pass around the tack or pin; draw it tightly and fasten it in the slit or clip at the end. Lay the apparatus on a smooth sheet of paper, place the point of a pencil at E, and keeping the string tight pass it around and describe the curve, just in the same manner as when the two ends of the string are fastened to the paper at the foci. The chief advantage claimed over the usual method is that it may be applied to metal and stone, where it is difficult to attach a string. On drawings it avoids the necessity of perforating the paper with pins.

As the pencil point is liable to slip out of the loop formed by the string, it should have a nick cut or filed in one side, like a crochet needle.

As the mechanic frequently wants to make an oval having a given width and length, but does not know what the distance between the foci must be to produce this effect, a few directions on this point may be useful:

It is a fact well known to mathematicians that if the distance between the foci and the shorter diameter of an ellipse be made the sides of a right angled triangle, its hypotenuse will equal the greater diameter. Hence in order to find the distance between the foci, when the length and width of the ellipse are known, these two are squared and the lesser square subtracted from the greater, when the square root of the difference will be the quantity sought. For example, if it be required to describe an ellipse that shall have a length of 5 inches and a width of 3 inches, the distance between the foci will be found as follows:

$$(5 \times 5) - (3 \times 3) = (4 \times 4)$$

or

$$\underline{25} - 9 = 16 \text{ and } \sqrt{16} = 4.$$

In the shop this distance may be found experimentally by laying a foot rule on a square so that one end of the former will touch the figure marking the lesser diameter on the latter, and then bringing the figure on the rule that represents the greater diameter to the edge of the square; the figure on the square at this point is the distance sought. Unfortunately they rarely represent whole numbers. We present herewith a table giving

the width to the eighth of an inch for several different ovals when the length and distance between foci are given.

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Length. Inches.	Distance between foci. Inches.	Width. Inches.
2	1	1 3/4
2	1 1/2	1 1/4
2 1/2	1	2 1/4
2 1/2	1 1/2	2
2 1/2	2	1 1/2
3 1 11/2	3 11/2	2-7/8
3 2	2-5/8	3 21/2
21/4	31/2	1 3-3/8
31/2	11/2	3-1/8
31/2	2	2-7/8
31/2	2	31/2
21/2	21/2	31/2
3	13/4	4
2	31/2	4
4	2 1/2	3-1/8
4	3	2-5/8
4	31/2	4
5	3	4
5	4	3

For larger ovals multiples of these numbers may be taken; thus for 7 and 4, take from the table twice the width corresponding to 3 1/2 and 2, which is twice 2-7/8, or 5 3/4. It will be noticed also that columns 2 and 3 are interchangeable.

To use the apparatus in connection with the table: Find the length of the desired oval in the first column of the table, and the width most nearly corresponding to that desired in the third column. The corresponding number in the middle column tells which hole the needle must be passed through. The tack D, *around* which the string must pass, is so placed that the total length of the string AD + DC, or its equal AE + EC, shall equal the greater diameter of the ellipse. In the figure it is placed 6 1/2 inches from A, and 1 1/2 inches from C, making the total length of string 8 inches. The oval described will then be 8 inches long and 6 1/4 inches wide.

The above table will be found equally useful in describing ovals by fastening the ends of the string to the drawing as is recommended in all the text books on the subject. On the other hand, the instrument may be set "by guess" when no particular accuracy is required.

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THE MANUFACTURE OF CHARCOAL IN KILNS.

The manufacture of charcoal in kilns was declared many years ago, after a series of experiments made in poorly constructed furnaces, to be unprofitable, and the subject is dismissed by most writers with the remark, that in order to use the method economically the products of distillation, both liquid and gaseous, must be collected. T. Egleston, Ph.D., of the School of Mines, New York, has read a paper on the subject before the



American Institute of Mining Engineers, from which we extract as follows: As there are many SILVER DISTRICTS IN THE WEST where coke cannot be had at such a price as will allow of its being used, and where the ores are of such a nature that wood cannot be used in a reverberatory furnace, the most economical method of making charcoal is an important question.



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Kilns for the manufacture of charcoal are made of almost any shape and size, determined in most cases by the fancy of the builder or by the necessities of the shape of the ground selected. They do not differ from each other in any principle of manufacture, nor does there seem to be any appreciable difference in the quality of the fuel they produce, when the process is conducted with equal care in the different varieties; but there is a considerable difference in the yield and in the cost of the process in favor of small over large kilns. The different varieties have come into and gone out of use mainly on account of the cost of construction and of repairs. The object of a kiln is to replace the cover of a meiler by a permanent structure. Intermediate between the meiler and the kiln is the Foucauld system, the object of which is to replace the cover by a structure more or less permanent, which has all the disadvantages of both systems, with no advantages peculiar to itself.

The kilns which are used may be divided into the rectangular, the round, and the conical, but the first two seem to be disappearing before the last, which is as readily built and much more easily managed.

ALL VARIETIES OF KILNS

Are usually built of red brick, or, rarely, of brick and stone together. Occasionally, refractory brick is used, but it is not necessary. The foundations are usually made of stone. There are several precautions necessary in constructing the walls. The brick should be sufficiently hard to resist the fire, and should therefore be tested before using. It is an unnecessary expense to use either second or third quality fire-brick. As the pyroligneous acid which results from the distillation of the wood attacks lime mortar, it is best to lay up the brick with fire-clay mortar, to which a little salt has been added; sometimes loam mixed with coal-tar, to which a little salt is also added, is used. As the principal office of this mortar is to fill the joints, special care must be taken in laying the bricks that every joint is broken, and frequent headers put in to tie the bricks together. It is especially necessary that all the joints should be carefully filled, as any small open spaces would admit air, and would materially decrease the yield of the kiln. The floor of the kiln was formerly made of two rows of brick set edgewise and carefully laid, but latterly it is found to be best made of clay. Any material, however, that will pack hard may be used. It must be well beaten down with paving mauls. The center must be about six inches higher than the sides, which are brought up to the bottom of the lower vents. Most kilns are carefully pointed, and are then painted on the outside with a wash of clay suspended in water, and covered with a coating of coal-tar, which makes them waterproof, and does not require to be renewed for several years.

[Illustration: RECTANGULAR KILNS FOR THE MANUFACTURE OF CHARCOAL.]

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The kilns were formerly roofed over with rough boards to protect the masonry from the weather, but as no special advantage was found to result from so doing, since of late years they have been made water-proof, the practice has been discontinued.

The wood used is cut about one and a fifth meters long. The diameter is not considered of much importance, except in so far as it is desirable to have it as nearly uniform as possible. When most of the wood is small, and only a small part of it is large, the large pieces are usually split, to make it pack well. It has been found most satisfactory to have three rows of vents around the kiln, which should be provided with a cast-iron frame reaching to the inside of the furnace. The vents near the ground are generally five inches high—the size of two bricks—and four inches wide—the width of one—and the holes are closed by inserting one or two bricks in them. They are usually the size of one brick, and larger on the outside than on the inside. These holes are usually from 0.45 m. to 0.60 m. apart vertically, and from 0.80 m. to 0.90 m. apart horizontally. The lower vents start on the second row of the brickwork above the foundation, and are placed on the level with the floor, so that the fire can draw to the bottom. There is sometimes an additional opening near the top to allow of the rapid escape of the smoke and gas at the time of firing, which is then closed, and kept closed until the kiln is discharged. This applies mostly to the best types of conical kilns. In the circular and conical ones the top charging door is sometimes used for this purpose. Hard and soft woods are burned indifferently in the kilns. Hard-wood coal weighs more than soft, and the hard variety of charcoal is usually preferred for blast furnaces, and for such purposes there is an advantage of fully 33-1/3 per cent. or even more in using hard woods. For the direct process in the bloomeries, soft-wood charcoal is preferred. It is found that it is not usually advantageous to build kilns of over 160 to 180 cubic meters in capacity. Larger furnaces have been used, and give as good a yield, but they are much more cumbersome to manage. The largest yield got from kilns is from 50 to 60 bushels for hard wood to 50 for soft wood. The average yield, however, is about 45 bushels. In meilers, two and a half to three cords of wood are required for 100 bushels, or 30 to 40 bushels to the cord. The kiln charcoal is very large, so that the loss in fine coal is very much diminished. The pieces usually come out the whole size, and sometimes the whole length of the wood.

The rectangular kilns were those which were formerly exclusively in use. They are generally built to contain from 30 to 90 cords of wood. The usual sizes are given in the table below:

	1	2	3	4
Length	50	40	40	48
Width	12	15	14	17
Height	12	15	18	18
Capacity, in cords	55	70	75	90

1 and 2. Used in New England. 3. Type of those used in Mexico. 4. Kiln at Lauton, Mich.



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The arch is usually an arc of a circle. A kiln of the size of No. 4, as constructed at the Michigan Central Iron Works, with a good burn, will yield 4,000 bushels of charcoal.

The vertical walls in the best constructions are 12 to 13 feet high, and 1-1/2 brick thick, containing from 20 to 52 bricks to the cubic foot of wall. To insure sufficient strength to resist the expansion and contraction due to the heating and cooling, they should be provided with buttresses which are 1 brick thick and 2 wide, as at Wassaic, New York; but many of them are built without them, as at Lauton, Michigan, as shown in the engraving. In both cases they are supported with strong braces, from 3 to 4 feet apart, made of round or hewn wood, or of cast iron, which are buried in the ground below, and are tied above and below with iron rods, as in the engraving, and the lower end passing beneath the floor of the kiln. When made of wood they are usually 8 inches square or round, or sometimes by 8 inches placed edgewise. They are sometimes tied at the top with wooden braces of the same size, which are securely fastened by iron rods running through the corners, as shown. When a number of kilns are built together, as at the Michigan Central Iron Works, at Lauton, Michigan, shown in the plan view, only the end kilns are braced in this way. The intermediate ones are supported below by wooden braces, securely fastened at the bottom. The roof is always arched, is one brick, or eight inches, thick, and is laid in headers, fourteen being used in each superficial foot. Many of the kilns have in the center a round hole, from sixteen to eighteen inches in diameter, which is closed by a cast iron plate. It requires from 35 M. to 40 M. brick for a kiln of 45 cords, and 60 M. to 65 M. for one of 90 cords.

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The belief that population in the West Indies is stationary is so far from accurate that, as Sir Anthony Musgrave points out, it is increasing more rapidly than the population of the United Kingdom. The statistics of population show an increase of 16 per cent. on the last decennial period, while the increase in the United Kingdom in the ten years preceding the last census was under 11 per cent. This increase appears to be general, and is only slightly influenced by immigration. "The population of the West Indies," adds Sir A. Musgrave, "is now greater than that of any of the larger Australian colonies, and three times that of New Zealand."

* * * * *

HEAT DEVELOPED IN FORGING.



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M. Tresca has lately presented to the Academy of Sciences some very interesting experiments on the development and distribution of heat produced by a blow of the steam hammer in the process of forging. The method used was as follows: The bar was carefully polished on both sides, and this polished part covered with a thin layer of wax. It was then placed on an anvil and struck by a monkey of known weight, P , falling from a height, H . The faces of the monkey and anvil were exactly alike, and care was taken that the whole work, $T = PH$, should be expended upon the bar. A single blow was enough to melt the wax over a certain zone; and this indicated clearly how much of the lateral faces had been raised by the shock to the temperature of melting wax. The form of this melted part could be made to differ considerably, but approximated to that of an equilateral hyperbola. Let A be the area of this zone, b the width of the bar, d the density, C the heat capacity, and $t-t_0$ the excess of temperature of melting wax over the temperature of the air. Then, assuming that the area, A , is the base of a horizontal prism, which is everywhere heated to the temperature, t , the heating effect produced will be expressed by

$$Ab \times d \times C(t-t_0)$$

Multiplying this by 425, or Joule's equivalent for the metrical system, the energy developed in heat is given by

$$T_1 = 425 AbdC(t-t_0).$$

Dividing T_1 by T , we obtain the ratio which the energy developed in heat bears to the total energy of the blow.

With regard to the form of the zone of melting, it was found always to extend round the edges of the indent produced in the bar by the blow. We are speaking for the present of cases where the faces of the monkey and anvil were sharp. On the sides of the bar the zone took the form of a sort of cross with curved arms, the arms being thinner or thicker according to the greater or less energy of the shock. These forms are shown in Figs. 1 to 6. It will be seen that these zones correspond to the zones of greatest sliding in the deformation of a bar forged with a sharp edged hammer, showing in fact that it is the mechanical work done in this sliding which is afterward transformed into heat.

[Illustration]

With regard to the ratio, above mentioned, between the heat developed and the energy of the blow, it is very much greater than had been expected when the other sources of loss were taken into consideration. In some cases it reached 80 per cent., and in a table given the limits vary for an iron bar between 68.4 per cent. with an energy of 40 kilogram-meters, and 83.6 per cent. with an energy of 90 kilogram-meters. With copper the energy is nearly constant at 70 per cent. It will be seen that the proportion is less when the energy is less, and it also diminishes with the section of the bar. This is no

doubt due to the fact that the heat is then conducted away more rapidly. On the whole, the results are summed up by M. Tresca as follows:



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- (1) The development of heat depends on the form of the faces and the energy of the blow.
- (2) In the case of faces with sharp edges, the process described allows this heat to be clearly indicated.
- (3) The development of heat is greatest where the shearing of the material is strongest. This shearing is therefore the mechanical cause which produces the heating effect.
- (4) With a blow of sufficient energy and a bar of sufficient size, about 80 per cent. of the energy reappears in the heat.
- (5) The figures formed by the melted wax give a sort of diagram, showing the distribution of the heat and the character of the deformation in the bar.
- (6) Where the energy is small the calculation of the percentage is not reliable.

So far we have spoken only of cases where the anvil and monkey have sharp faces. Where the faces are rounded the phenomena are somewhat different. Figs. 7 to 12 give the area of melted wax in the case of bars struck with blows gradually increasing in energy. It will be seen that, instead of commencing at the edges of the indent, the fusion begins near the middle, and appears in small triangular figures, which gradually increase in width and depth until at last they meet at the apex, as in Fig. 12. The explanation is that with the rounded edges the compression at first takes place only in the outer layers of the bar, the inner remaining comparatively unaffected. Hence the development of heat is concentrated on these outer layers, so long as the blows are moderate in intensity. The same thing had already been remarked in cases of holes punched with a rounded punch, where the burr, when examined, was found to have suffered the greatest compression just below the punch. With regard to the percentage of energy developed as heat, it was about the same as in the previous experiments, reaching in one case, with an iron bar and with an energy of 110 kilogram-meters, the exceedingly high figure of 91 per cent. With copper, the same figure varied between 50 and 60 per cent.—*Iron*.

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A NOVEL PROPELLER ENGINE.

By Prof. C.W. MacCord.

The accompanying engravings illustrate the arrangement of a propeller engine of 20 inch bore and 22 inch stroke, whose cylinder and valve gear were recently designed by the writer, and are in process of construction by Messrs. Valk & Murdoch, of Charleston, S.C.



In the principal features of the engine, taken as a whole, as will be perceived, there is no new departure. The main slide valve, following nearly full stroke, is of the ordinary form, and reversed by a shifting link actuated by two eccentrics, in the usual manner; and the expansion valves are of the well known Meyer type, consisting of two plates on the back of the main valve, driven by a third eccentric, and connected by a right and left handed screw, the turning of which alters the distance between the plates and the point of cutting off.

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The details of this mechanism, however, present several novel features, of which the following description will be understood by reference to the detached cuts, which are drawn upon a larger scale than the general plan shown in Figs. 1 and 2.

[Illustration: Figs. 1-2 IMPROVED STEAM ENGINE.—BY PROF MACCORD.]

The first of these relates to the arrangement of the right and left handed screw, above mentioned, and of the device by which it is rotated.

Usually, the threads, both right handed and left handed, are cut upon the cut-off valve stem itself, which must be so connected with the eccentric rod as to admit of being turned; and in most cases the valve stem extends through both ends of the steam chest, so that it must both slide endwise and turn upon its axis in two stuffing boxes, necessarily of comparatively large size.

All this involves considerable friction, and in the engine under consideration an attempt has been made to reduce the amount of this friction, and to make the whole of this part of the gear neater and more compact, in the following manner:

Two small valve stems are used, which are connected at their lower ends by a crosstail actuated directly by the eccentric rod, and at their upper ends by a transverse yoke. This yoke, fitting snugly between two collars formed upon a sleeve which it embraces, imparts a longitudinal motion to the latter, while at the same time leaving it free to rotate.

This sleeve has cut upon it the right and left handed screws for adjusting the cut-off valves; and it slides freely upon a central spindle which has no longitudinal motion, but, projecting through the upper end of the valve chest, can be turned at pleasure by means of a bevel wheel and pinion. The rotation of the spindle is communicated to the sleeve by means of two steel keys fixed in the body of the latter and projecting inwardly so as to slide in corresponding longitudinal grooves in the spindle.

Thus the point of cutting off is varied at will while the engine is running, by means of the hand wheel on the horizontal axis of the bevel pinion, and a small worm on the same axis turns the index, which points out upon the dial the distance followed. These details are shown in Figs. 3, 4, and 5; in further explanation of which it may be added that Fig. 3 is a front view of the valve chest and its contents, the cover, and also the balance plate for relieving the pressure on the back of the main valve (in the arrangement of which there is nothing new), being removed in order to show the valve stems, transverse yoke, sleeve, and spindle above described. Fig. 4 is a longitudinal section, and Fig. 5 is a transverse section, the right hand side showing the cylinder cut by a plane through the middle of the exhaust port, the left hand side being a section by a plane above, for the purpose of exhibiting more clearly the manner in which the steam is admitted to the valve chest; the latter having no pipes for this service, the steam enters below the valve, at each end of the chest, just as it escapes in the center.

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The second noteworthy feature consists in this: that the cut-off eccentric is not keyed fast, as is customary when valve gear of this kind is employed, but is loose upon the shaft, the angular position in relation to the crank being changed when the engine is reversed; two strong lugs are bolted on the shaft, one driving the eccentric in one direction, the other in the opposite, by acting against the reverse faces of a projection from the side of The eccentric pulley.

The loose eccentric is of course a familiar arrangement in connection with poppet valves, as well as for the purpose of reversing an engine when driving a single slide valve. Its use in connection with the Meyer cut-off valves, however, is believed to be new; and the reason for its employment will be understood by the aid of Fig. 6.

For the purposes of this explanation we may neglect the angular vibrations of the connecting rod and eccentric rod, considering them both as of infinite length. Let O be the center of the shaft; let $L O M$ represent the face of the main valve seat, in which is shown the port leading to the cylinder; and let A be the edge of the main valve, at the beginning of a stroke of the piston. It will then be apparent that the center of the eccentric must at that instant be at the point, C , if the engine turn to the left, as shown by the arrow, and at G , if the rotation be in the opposite direction; C and G then may be taken as the centers of the "go-ahead" and the "backing" eccentrics respectively, which operate the main valve through the intervention of the link.

Now, in each revolution of the engine, the cut-off eccentric in effect revolves in the same direction about the center of the main eccentric. Consequently, we may let $R C S$, parallel to $L O M$, represent the face of the cut-off valve seat, or, in other words, the back of the main valve, in which the port, $C N$, corresponds to one of those shown in Fig. 4; and the motion of the cut-off valve over this seat will be precisely, the same as though it were driven directly by an eccentric revolving around the center, C .

In determining the position of this eccentric, we proceed upon the assumption that the best results will be effected by such an arrangement that when cutting off at the earliest point required, the cut-off valve shall, at the instant of closing the port, be moving over it at its highest speed. And this requires that the center of the eccentric shall at the instant in question lie in the vertical line through C .

[Illustration: Figs. 3-12 IMPROVED STEAM ENGINE.—BY PROF MACCORD.]

Next, the least distance to be followed being assigned, the angle through which the crank will turn while the piston is traveling that distance is readily found; then, drawing an indefinite line $C T$, making with the vertical line, $G O$, an angle, $G C T$, equal to the one thus determined, any point upon that line may be assumed as the position of the required center of the cut-off eccentric, at the beginning of the stroke.

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But again, in order that the cut-off may operate in the same manner when backing as when going ahead, this eccentric must be symmetrically situated with respect to both C and G; and since L O M bisects and is perpendicular to G C, it follows that if the cut-off eccentric be fixed on the shaft, its center must be located at H, the intersection of C T with L M. This would require the edge of the cut-off valve at the given instant to be at Q, perpendicularly over H; and the travel over the main valve would be equal to twice C H, the virtual lever arm of the eccentric, the actual traverse in the valve chest being twice O H, the real eccentricity.

This being clearly excessive, let us next see what will occur if the lever arm, CH, be reduced as in the diagram to CK. The edge of the cut-off valve will then be at N; it instantly begins to close the port. CN, but not so rapidly as the main valve opens the port, AB.

The former motion increases in rapidity, while the latter decreases; therefore at some point they will become equal in velocity, and the openings of the two ports will be the same; and the question is, Will this maximum effective port area give a sufficient supply of steam?

This diagram is the same as the one actually used in the engine under consideration, in which it was required to follow a minimum distance of 5 inches in the stroke of 22. Under these conditions it is found that the actual port opening for that point of cutting off is three-fifths of that allowed when following full stroke, whereas the speed of the piston at the time when this maximum opening occurs is less than half its greatest speed.

This, it would seem, is ample; but we now find the eccentric, K, no longer in the right position for backing; when the engine is reversed it ought to be at, P, the angle, POL, being equal to the angle, KOL. By leaving it free, therefore, to move upon the shaft, by the means above described, through the angle, KOP, the desired object is accomplished. The real eccentricity is now reduced in the proportion of OK to OH, while the lengths of the cut-off valves, and what is equally important, their travel over the back of the main valve, are reduced in the proportion of CK to CH, in this instance nearly one-half; a gain quite sufficient to warrant the adoption of the expedient.

The third, and perhaps the most notable, peculiarity is the manner of suspending and operating the main link. As before stated, this link is used only for reversing, and is therefore always in "full gear" in one direction or the other; and the striking feature of the arrangement here used is that, whether going ahead or backing, there is *no slipping of the link upon the link block*.

The link itself is of the simplest form, being merely a curved flat bar, L, in which are two holes, A and B (Fig. 7), by which the link is hung upon the pins, which project from the sides of the eccentric rods at their upper ends.

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This is most clearly shown in Fig. 8, which is a top view of the reversing gear. The link block is a socket, open on the side next to the eccentric rods, but closed on the side opposite, from which projects the journal, J, as shown in Fig. 9, which is a vertical section by the plane, XY. This journal turns freely in the outer end of a lever, M, which transmits the reciprocating motion to the valve, through the rock-shaft, O, and another lever, N. Connected with the lever, M, by the bridge-piece, K, and facing it, is a slotted arm, G, as shown in the end view, Fig. 10. The center line of this slot lies in the plane which contains the axes of the journal, J, and of the shaft, O.

A block, E, is fitted to slide in the slotted arm, G; and in this block is fixed a pin, P. A bridle-rod, R, connects P with the pin, A, of one of the eccentric-rods, prolonged for that purpose as shown in Fig. 8; and a suspension-rod, S, connects the same pin, P, with the upper end of the reversing lever, T, which is operated by the worm and sector. The distance, JO, in Fig. 10, or in other words the length of the lever, M, is precisely equal to the distance, AB, in Fig. 7, measured in a right line; and the rods, R and S, from center to center of the eyes, are also each of precisely this same length. Further, the axis about which the reversing lever, T, vibrates is so situated that when that lever, as in Fig 11, is thrown full to the left, the pin in its upper end is exactly in line with the rock-shaft, O.

When the parts are in this position, the suspension-rod, S, the arm, G, and the lever, M, will be as one piece, and their motions will be identical, consisting simply of vibration about the axis of the rock-shaft, O. The motion of the lever, M, is then due solely to the pin, B, which is in this case exactly in line with the journal, J, so that the result is the same as though this eccentric rod were connected directly to the lever; and the pin, P, being also in line with B and J, and kept so by the suspension-rod, S, it will be seen that the bridle-rod, R, will move with the link, L, as though the two were rigidly fastened together.

When the reversing lever, T, is thrown full to the right, as in Fig. 12, the pin, P, is drawn to the inner end of the slot in the arm, G, and is thus exactly in line with the rock-shaft, O. The suspension-rod, S, will, therefore, be at rest; but the pin, A, will have been drawn, by the bridle-rod, R, into line with the journal, J, and the bridle-rod itself will now vibrate with the lever, M, whose sole motion will be derived from the pin, A.

There is, then, no block slip whatever when the link thus suspended and operated is run in "full gear," either forward or backward.



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If this arrangement be used in cases where the link is used as an expansion device, there will be, of course, some block slip while running in the intermediate gears. But even then, it is to be observed that the motion of the pin, A, relatively to the rocker arm is one of vibration about the moving center, J; and its motion relatively to the sliding block, E, is one of vibration about the center, P, whose motion relatively to E is a small amount of sliding in the direction of the slot, due to the fact that the rocker arm itself, which virtually carries the block, E, vibrates about O, while the suspension-rod, S, vibrates about another fixed center. It will thus be seen that, finally, the block slip will be determined by the difference in curvature of arcs *which curve in the same direction*, whether the engine be running forward or backward; whereas in the common modes of suspension the block slip in one direction is substantially the half sum of the curvatures of two arcs curving in opposite directions.

Consequently it would appear that the average action of the new arrangement would be at least equal to that of the old in respect to reducing the block slip when running in the intermediate gears, while in the full gears it entirely obviates that objectionable feature.

* * * * *

THE NEW RUSSIAN TORPEDO BOAT, THE POTI.

The Russian government has just had built at the shipyards of Mr. Normand, the celebrated Havre engineer, a torpedo boat called the Poti, which we herewith illustrate. This vessel perceptibly differs from all others of her class, at least as regards her model. Her extremities, which are strongly depressed in the upperworks, and the excessive inclination of her sides, give the boat as a whole a certain resemblance to the rams of our navy, such as the Taureau and Tigre.

[Illustration: THE NEW RUSSIAN TORPEDO BOAT, THE "POTI".]

A transverse section of the Poti approaches an ellipse in shape. Her water lines are exceedingly fine, and, in point of elegance, in no wise cede to those of the most renowned yachts. The vessel is entirely of steel, and her dimensions are as follows: Length, 28 meters; extreme breadth, 3.6 meters; depth, 2.5 meters; draught, 1.9 meters; displacement, 66 tons. The engine, which is a compound one, is of 600 H.P. The minimum speed required is 18 knots, or 33-34 meters, per hour, and it will probably reach 40 kilometers.

The vessel will be armed with 4 Whitehead torpedoes of 5.8 m., and 2 Hotchkiss guns of 40 cm. Her supply of coal will be sufficient for a voyage of 1000 nautical miles at a speed of 11 knots.—*L'Illustration*.

* * * * *



A NEW STEAMER PROPELLED BY HYDRAULIC REACTION.

The oar, the helix, and the paddle-wheel constitute at present the means of propulsion that are exclusively employed when one has recourse to a motive power for effecting the propulsion of a boat. The sail constitutes an entirely different mode, and should not figure in our enumeration, considering the essentially variable character of the force utilized.



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In all these propellers, we have only an imitation, very often a rude one, of the processes which nature puts in play in fishes and mollusks, and the mode that we now wish to make known is without contradiction that which imitates these the best.

Hydraulic propulsion by reaction consists, in principle, in effecting a movement of boats, by sucking in water at the bow and forcing it out at the stern. This is a very old idea. Naturalists cite whole families of mollusks that move about in this way with great rapidity. It is probable that such was the origin of the first idea of this mode of operating. However this may be, as long ago as 1661 a patent was taken out in England, on this principle, by Toogood & Hayes. After this we find the patents of Allen (1729) and Rumsay (1788). In France, Daniel Bernouilli presented to the Academic des Sciences a similar project during the last century.

Mr. Seydell was the first to build a vessel on this principle. This ship, which was called the Enterprise, was of 100 tons burden, and was constructed at Edinburgh for marine fishery. The success of this was incomplete, but it was sufficient to show all the advantage that could be got from the idea. Another boat, the Albert, was built at Stettin, after the same type and at about the same epoch; and the question was considered of placing a reaction propeller upon the Great Eastern.

About 1860 the question was taken up again by the house of Cokerill de Seraing, which built the Seraing No. 2, that did service as an excursion boat between Liege and Seraing. The propeller of this consisted of a strong centrifugal pump, with vertical axis, actuated by a low pressure engine. This pump sucked water into a perforated channel at the bottom of the boat, and forced it through a spiral pipe to the propelling tubes. These latter consisted of two elbowed pipes issuing from the sides of the vessel and capable of pivoting in the exhaust ports in such a way as to each turn its mouth downward at will, backward or forward. The water expelled by the elbowed pipes reacted through pressure, as in the hydraulic tourniquet of cabinets of physics, and effected the propulsion of the vessel. Upon turning the two mouths of the propelling tubes backward, the boat was thrust forward, and, when they were turned toward the front, she was thrust backward. When one was turned toward the front and the other toward the stern, the boat swung around. Finally, when the two mouths were placed vertically the boat remained immovable. All the evolutions were easy, even without the help of the rudder, and the ways in which the propelling tubes could be placed were capable of being varied *ad infinitum* by a system of levers.

The Seraing No. 2 had an engine of a nominal power of 40 horses, and took on an average 30 minutes to make the trip, backward and forward, of 85 kilometers, with four stoppages.

The success obtained was perfect, and the running was most satisfactory. It was remarked, only, that from the standpoint of effective duty it would have been desirable to reduce the velocity of the water at its exit from the propellers.

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Mr. Poillon attributes the small effective performance to the system employed for putting the water in motion. At time of Mr. Seraing's experiments, only centrifugal force pumps were known, and the theoretic effective duty of these, whatever be the peculiar system of construction, cannot exceed 66 per cent., and, in practice, falls to 40 or 50 per cent. in the majority of cases.

It is probable, then, that in making use of those new rotary pumps where effective duty reaches and often exceeds 80 per cent., we might obtain much better results, and it is this that justifies the new researches that have been undertaken by Messrs. Maginot & Pinette, whose first experiments we are about to make known.

In order to have it understood what interest attaches to these researches, let us state the principal advantages that this mode of propulsion will have over the helix and paddle wheel: The width of side-wheel boats will be reduced by from 20 to 30 per cent., and the draught of water will be diminished in screw steamers to that of the hull itself; the maneuver in which the power of the engine might be directly employed will be simplified; a machine will be had of a sensibly constant speed, and without change in its running; the production of waves capable of injuring the banks of canals will be avoided; the propeller will be capable of being utilized as a bilge pump; all vibration will be suppressed; the boat will be able to run at any speed under good conditions, while the helix works well only when the speed of the vessel corresponds to its pitch; it will be possible to put the propelling apparatus under water; and, finally, it will be possible to run the pump directly by the shaft of the high speed engine, without intermediate gearing, which is something that would prove a very great advantage in the case of electric pleasure boats actuated by piles and accumulators and dynamo-electric machines.

[Illustration: NEW STEAMER PROPELLED BY HYDRAULIC REACTION.]

We now arrive at Messrs. Maginot & Pinette's system, the description of which will be greatly facilitated by the diagram that accompanies this article. The inventors have employed a boat 14 meters in length by 1.8 m. in width, and 65 centimeters draught behind and 32 in front. The section of the midship beam is 70 square decimeters, and that of the exhaust port is 4. At a speed of 2.2 meters per second the tractive stress, K , is from 10 to 11 kilogrammes. At a speed of 13.5 kilometers per hour, or 3.75 meters per second, the engine develops a power of 12 horses. The piston is 19 centimeters in diameter, and has a stroke of 15 centimeters. The shaft, in common, of the pump and engine makes 410 revolutions per minute. It will be seen from the figure that suction occurs at the lower part of the hull, at A, and that the water is forced out at B, to impel the vessel forward. C and C' are the tubes for putting the vessel about, and DD' the tubes for causing her to run backward. Owing to the tubes, C, C', the rudder has but small dimensions and is only used for *directing* the boat. The vessel may be turned about *in situ* by opening one of the receiving tubes, according to the side toward which it is desired to turn.



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This boat is as yet only in an experimental state, and the first trials of her that have recently been made upon the Saone have shown the necessity of certain modifications that the inventors are now at work upon.—*La Nature*.

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A NEW FORM OF FLEXIBLE BAND DYNAMOMETER.

[Footnote: Read before Section G of British Association.]

By Professor W.C. UNWIN.

[Illustration: Fig. 1.]

In the ordinary strap dynamometer a flexible band, sometimes carrying segments of wood blocks, is hung over a pulley rotated by the motor, the power of which is to be measured. If the pulley turns with left-handed rotation, the friction would carry the strap toward the left, unless the weight, Q , were greater than P . If the belt does not slip in either direction when the pulley rotates under it, then $Q-P$ exactly measures the friction on the surface of the pulley; and V being the surface velocity of the pulley $(Q-P)V$, is exactly the work consumed by the dynamometer. But the work consumed in friction can be expressed in another way. Putting $[\theta]$ for the arc embraced by the belt, and $[\mu]$ for the coefficient of friction,

$$Q/P = [\epsilon]^{[\mu]^{[\theta]}}$$

or for a given arc of contact $Q = [\kappa]P$, where $[\kappa]$ depends only on the coefficient of friction, increasing as $[\mu]$ increases, and *vice versa*. Hence, for the belt to remain at rest with two fixed weights, Q and P , it is necessary that the coefficient of friction should be exactly constant. But this constancy cannot be obtained. The coefficient of friction varies with the condition of lubrication of the surface of the pulley, which alters during the running and with every change in the velocity and temperature of the rubbing surfaces. Consequently, in a dynamometer in this simple form more or less violent oscillations of the weights are set up, which cannot be directly controlled without impairing the accuracy of the dynamometer. Professors Ayrton and Perry have recently used a modification of this dynamometer, in which the part of the cord nearest to P is larger and rougher than the part nearest to Q . The effect of this is that when the coefficients of friction increase, Q rises a little, and diminishes the amount of the rougher cord in contact, and *vice versa*. Thus reducing the friction, notwithstanding the increase of the coefficient. This is very ingenious, and the only objection to it, if it is an objection, is that only a purely empirical adjustment of the friction can be obtained, and that the range of the adjustment cannot be very great. If in place of one of the weights

we use a spring balance, as in Figs. 2 and 3, we get a dynamometer which automatically adjusts itself to changes in the coefficient of friction.

[Illustration: FIG.2 FIG.3]

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For any increase in the coefficient, the spring in Fig. 2 lengthens, Q increases, and the frictional resistance on the surface of the pulley increases, both in consequence of the increase of Q , which increases the pressure on the pulley, and of the increase of the coefficient of friction. Similarly for any increase of the coefficient of friction, the spring in Fig. 3 shortens, P diminishes, and the friction on the surface of the pulley diminishes so far as the diminution of P diminishes the normal pressure, but on the whole increases in consequence of the increase of the coefficient of friction. The value of the friction on the surface of the pulley, however, is more constant for a given variation of the frictional coefficient in Fig. 3 than in Fig. 2, and the variation of the difference of tensions to be measured is less. Fig. 3, therefore, is the better form.

A numerical calculation here may be useful. Supposing the break set to a given difference of tension, $Q-P$, and that in consequence of any cause the coefficient of friction increases 20 per cent., the difference of tensions for an ordinary value of the coefficient of friction would increase from $1.5 P$ to $2 P$ in Fig. 2, and from $1.5 P$ to $1.67 P$ in Fig. 3. That is, the vibration of the spring, and the possible error of measurement of the difference of tension would be much greater in Fig. 2 than in Fig. 3. It has recently occurred to the author that a further change in the dynamometer would make the friction on the pulley still more independent of changes in the coefficient of friction, and consequently the measurement of the work absorbed still more accurate. Suppose the cord taken twice over a pulley fixed on the shaft driven by the motor and round a fixed pulley, C .

For clearness, the pulleys, $A B$, are shown of different sizes, but they are more conveniently of the same size. Further, let the spring balance be at the free end of the cord toward which the pulley runs. Then it will be found that a variation of 20 per cent. in the friction produces a somewhat greater variation of P than in Fig. 3. But P is now so much smaller than before that $Q-P$ is much less affected by any error in the estimate of P . An alteration of 20 per cent. in the friction will only alter the quantity $Q-P$ from $5.25 P$ to $5.55 P$, or an alteration of less than 6 per cent.

[Illustration: FIG. 4]

To put it in another way, the errors in the use of dynamometer are due to the vibration of the spring which measures P , and are caused by variations of the coefficient of friction of the dynamometer. By making P very much smaller than in the usual form of the dynamometer, any errors in determining it have much less influence on the measurement of the work absorbed. We may go further. The cord may be taken over four pulleys; in that case a variation of 20 per cent. in the frictional coefficient only alters the total friction on the pulleys $11/4$ percent. P is now so insignificant compared with Q that an error in determining it is of comparatively little consequence.



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[Illustration: FIG. 5]

The dynamometer is now more powerful in absorbing work than in the form Fig. 3. As to the practical construction of the brake, the author thinks that simple wires for the flexible bands, lying in V grooves in the pulleys, of no great acuteness, would give the greatest resistance with the least variation of the coefficient of friction; the heat developed being in that case neutralized by a jet of water on the pulley. It would be quite possible with a pulley of say 3 feet diameter, and running at 50 feet of surface velocity per second, to have a sufficiently flexible wire, capable of carrying 100 lb. as the greater load, Q . Now with these proportions a brake of the form in Fig. 3 would, with a probable value of the coefficient of friction, absorb 6 horse power. With a brake in the form Fig. 4, 8.2 horse power would be absorbed; and with a brake in the form Fig. 5, 8.8 horse power would be absorbed. But since it would be easy to have two, three, or more wires side by side, each carrying its load of 100 lb., large amounts of horsepower could be conveniently absorbed and measured.

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SEE'S GAS STOVE.

This stove consists of two or more superposed pipes provided with radiators. A gas burner is placed at the entrance of either the upper or lower pipe, according to circumstances. The products of combustion are discharged through a pipe of small diameter, which may be readily inserted into an already existing chimney or be hidden behind the wainscoting. The heat furnished by the gas flame is so well absorbed by radiation from the radiator rings that the gases, on making their exit, have no longer a temperature of more than from 35 to 40 degrees.

[Illustration: SEE'S GAS STOVE.]

The apparatus, which is simple, compact, and cheap, is surrounded on all sides with an ornamented sheet iron casing. Being entirely of cast iron, it will last for a long time. The joints, being of asbestos, are absolutely tight, so as to prevent the escape of bad odors. The water due to the condensation of the gases is led through a small pipe out of doors or into a vessel from whence it may evaporate anew, so as not to change the hygrometric state of the air. The consumption of gas is very small, it taking but 250 liters per hour to heat a room of 80 cubic meters to a temperature of 18 deg. C.—*Revue Industrielle*.

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The number of persons killed by wild animals and snakes in India last year was 22,125, against 21,427 in the previous year, and of cattle, 46,707, against 44,669. Of the



human beings destroyed, 2,606 were killed by wild animals, and 19,519 by snakes. Of the deaths occasioned by the attacks of wild animals, 895 were caused by tigers, 278 by wolves, 207 by leopards, 356 by jackals, and 202 by alligators; 18,591 wild animals and 322,421 snakes were destroyed, for which the Government paid rewards amounting to 141,653 rupees.

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RECTIFICATION OF ALCOHOL BY ELECTRICITY.

Some time ago, Mr. Laurent Naudin, it will be remembered,[1] devised a method of converting the aldehydes that give a bad taste and odor to impure spirits, into alcohol, through electrolytic hydrogen, the apparatus first employed being a zinc-copper couple, and afterward electrolyzers with platinum plates.

[Footnote 1: See SCIENTIFIC AMERICAN SUPPLEMENT of July 29, 1882, p. 5472.]

His apparatus had been in operation for several months, in the distillery of Mr. Boulet, at Bapeaume-les-Rouen, when a fire in December, 1881, completely destroyed that establishment. In reconstructing his apparatus, Mr. Naudin has availed himself of the experience already acquired, and has necessarily had to introduce important modifications and simplifications into the process. In the zinc-copper couple, he had in the very first place proposed to employ zinc in the form of clippings; but the metal in this state presents grave inconveniences, since the subsidence of the lower part, under the influence of the zinc's weight, soon proves an obstacle to the free circulation of the liquids, and, besides this, the cleaning presents insurmountable difficulties. This is why he substituted for the clippings zinc in straight and corrugated plates such as may be easily found in commerce. The management and cleaning of the pile thus became very simple.

[Illustration: FIG. 1.—APPARATUS FOR HYDROGENIZING IMPURE SPIRITS.]

The apparatus that contains the zinc-copper couple now has the form shown in Fig. 1. It may be cylindrical, as here represented, or, what is better, rectangular, because of the square form under which the sheets of zinc are found in commerce.

In this vessel of wood or iron plate, P, the corrugated zinc plates, b, b', b", are placed one above the other, each alternating with a flat one, a, a', a". These plates have previously been scoured, first with a weak solution of caustic soda in order to remove every trace of fatty matter derived from rolling, and then with very dilute hydrochloric acid, and finally are washed with common water. In order to facilitate the disengagement of hydrogen during the reaction, care must be taken to form apertures in the zinc plates, and to incline the first lower row with respect to the bottom of the vessel. A cubical pile of 150 hectoliters contains 105 rows of No. 16 flat and corrugated zinc plates, whose total weight is 6,200 kilogrammes. We obtain thus a hydrogenizing surface of 1,800 square meters, or 12 square meters per hectoliter of impure spirits of 50 deg. to 60 deg. Gay-Lussac. The raw impure spirits enter the apparatus through the upper pipe, E, and, after a sufficient stay therein, are drawn off through the lower pipe, H, into a reservoir, R, from whence, by means of a pump, they are forced to the rectifier.

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The hydrogen engendered during the electrolysis is disengaged through an aperture in the cover of the pile.

As a measure of precaution, the hydrogen saturated with alcoholic vapors may be forced to traverse a small, cooled room. The liquefied alcohol returns to the pile. At a mean temperature of 15 deg., the quantity of alcohol carried along mechanically is insignificant. In order to secure a uniformity of action in all parts of the spirits, during the period devoted to the operation, the liquid is made to circulate from top to bottom by means of a pump, O. The tube, N, indicates the level of the liquid in the vessel. The zinc having been arranged, the first operation consists in forming the couple. This is done by introducing into the pile, by means of the pump, O, a solution of sulphate of copper so as to completely fill it.

The adherence of the copper to the zinc is essential to a proper working of the couple, and may be obtained by observing the following conditions:

1. Impure spirits of 40 deg. Gay-Lussac, and not water, should be used as a menstruum for the salt of copper.
2. The sulphatization should be operated by five successive solutions of 1/2 per cent., representing 20 kilogrammes of sulphate of copper per 100 square meters of zinc exposed, or a total of 360 kilogrammes of sulphate for a pile of 150 hectoliters capacity.
3. A temperature of 25 deg. should not be exceeded during the sulphatization.

The use of spirits is justified by the fact that the presence of the alcohol notably retards the precipitation of copper. As each charging with copper takes twenty-four hours, it requires five days to form the pile. At the end of this time the deposit should be of a chocolate-brown and sufficiently adherent; but the adherence becomes much greater after a fortnight's operation.

Temperature has a marked influence upon the rapidity and continuity of the reaction. Below +5 deg. the couple no longer works, and above +35 deg. the reaction becomes vigorous and destroys the adherence of the copper to such a degree that it becomes necessary to sulphatize the pile anew. The battery is kept up by adding every eight days a few thousandths of hydrochloric acid to a vatful of the spirits under treatment, say 5 kilos. of acid to 150 hectoliters of spirits. The object of adding this acid is to dissolve the hydrate of oxide of zinc formed during the electrolysis and deposited in a whitish stratum upon the surface of the copper. The pile required no attention, and it is capable of operating from 18 months to two years without being renewed or cleaned.

[Illustration: FIG. 2.—ELECTROLYZING APPARATUS.]

Passing them over, the zinc-copper couple does not suffice to deodorize the impure spirits, so they must be sent directly to a rectifier. But, in certain cases, it is necessary to follow up the treatment by the pile with another one by electrolysis. The voltameters in which this second operation is performed have likewise been modified. They consist now (Fig. 2) of cylindrical glass vessels, AH, 125 mm. in diameter by 600 in height, with polished edges. These are hermetically closed by an ebonite cover through which pass the tubes, B' C' and B C, that allow the liquid, E+E-E'+E', to circulate.

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The current of spirits is regulated at the entrance by the cock, R, which, through its division plate, gives the exact discharge per hour. In addition, in order to secure great regularity in the flow, there is placed between the voltameters and the reservoir that supplies them a second and constant level reservoir regulated by an automatic cock.

In practice, Mr. Naudin employs 12 voltameters that discharge 12 hectoliters per hour, for a distillery that handles 300 hectoliters of impure spirits every 24 hours. The electric current is furnished to the voltameters by a Siemens machine (Fig. 3) having inductors in derivation, the intensity being regulated by the aid of resistance wires interposed in the circuit of the inductors.

The current is made to pass into the series of voltameters by means of a commutator, and its intensity is shown by a Deprez galvanometer. The voltameters, as shown in the diagram, are mounted in derivation in groups of two in tension. The spirits traverse them in two parallel currents. The Siemens machine is of the type SD2, and revolves at the rate of 1,200 times per minute, absorbing a motive power of four horses.

[Illustration: FIG. 3.—ARRANGEMENT OF THE SIEMENS MACHINE.]

The disacidification, before entering the rectifier, is effected by the metallic zinc. Let us now examine what economic advantages this process presents over the old method of rectifying by pure and simple distillation. The following are the data given by Mr. Naudin:

In ordinary processes (1) a given quantity of impure alcohol must undergo five rectifications in order that the products composing the mixture (pure alcohol, oils, *etc.*) may be separated and sold according to their respective quality; (2) the mean yield in the first distillation does not exceed 60 cent.; (3) the loss experienced in distillation amounts, for each rectification, to 4 per cent.; (4) the quantity of essential oils (mixture of the homologues of ethylic alcohol) collected at the end of the first distillation equals, on an average, 3.5 per cent.; (5) the cost of a rectification may be estimated at, on an average, 4 francs per hectoliter.

All things being equal, the yield in the first operation by the electric method is 80 per cent., and the treatment costs, on an average, 0.40 franc per hectoliter. The economy that is realized is therefore considerable. For an establishment in which 150 hectoliters of 100 deg. alcohol are treated per day this saving becomes evident, amounting, as it does, to 373 francs.

We may add that the electric process permits of rectifying spirits which, up to the present, could not be rectified by the ordinary processes. Mr. Naudin's experiments have shown, for example, that artichoke spirits, which could not be utilized by the old processes, give through hydrogenation an alcohol equal to that derived from Indian corn.—*La Nature*.

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PLASTIC CARBON FOR BATTERIES.

Max Nitsche-Niesky recommends the following in *Neueste Erfindung.*: Good coke is ground and mixed with coal-tar to a stiff dough and pressed into moulds made of iron and brass. After drying for a few days in a closed place, it is heated in a furnace where it is protected from the direct flames and burned, feebly at first, then strongly, the fire being gradually raised to white heat which is maintained for 6 or 8 hours. The fire is then permitted to slowly go down, and when perfectly cold the carbon is taken out of the furnace.

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RECENT STUDIES ON THE CONSTITUTION OF THE ALKALOIDS.

By SAMUEL P. SADTLER, Ph.D.

[Footnote: Introductory lecture, Course of 1883-84, Philadelphia College of Pharmacy.]

The sciences of to-day present, as might be expected, a very different aspect from the same branches of knowledge as they appeared fifty or sixty years ago. It is not merely that the mass of observations in most of these lines of study has enormously increased during this interval. Were that all, the change could hardly be considered as an unmixed benefit, because of the increased difficulty of assimilation of this additional matter. Many would be the contradictions in the observations and hopeless would be the task of bringing order out of such a chaos. The advance in the several branches of knowledge has been largely one resulting from improved methods of study, rather than one following simply from diligence in the application of the old ways.

Let us turn to chemistry for our illustration of this. The chemistry of the last century and the early decades of this was largely a descriptive science, such as the natural history branches, zoology, and botany are still in great part. Reasonably exact mineral analyses were made, it is true, but the laws of chemical combination and the fundamental conceptions of atoms and molecules had not been as yet generally established. Now, this want of comprehensive views of chemical reactions, their why and wherefore, was bad enough as it affected the study of inorganic and metallic compounds, but what must have been the conditions for studying the complex compounds of carbon, so widely spread in the vegetable and animal kingdoms. Their number is so enormous that, in the absence of any established relationships, not much more than a mere enumeration was possible for the student of this branch of chemistry. It is only within the last twenty years that chemists have attained to any comprehensive views at all in the domain of organic chemistry. It has been found possible to gradually

range most carbon compounds under two categories, either as marsh-gas or as benzol derivatives, as fatty compounds or as aromatic compounds. To do this, methods of analysis very different from those used in mineral chemistry

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had to be applied. The mere finding out of percentage composition tells us little or nothing about an organic compound. What the elements are that compose the compound is not to be found out. That can be told beforehand with almost absolute certainty. What is wanted is to know how the atoms of carbon, hydrogen, oxygen, and nitrogen are linked together, for, strange to say, these differences of groupings, which may be found to exist between these three or four elements, endow the compounds with radically different properties and serve us as a basis of classification.

The development of this part of chemistry, therefore, required very different methods of research. Instead of at once destroying a compound in order to learn of what elements it was composed, we submit it to a course of treatment with reagents, which take it apart very gradually, or modify it in the production of some related substance. In this way, we are enabled to establish its relations with well defined classes and to put it in its proper place. Of equal importance with the analytical method of study, however, is the synthetical. This method of research, as applied to organic compounds, embodies in it the highest triumphs of modern chemistry. It has been most fruitful of results, both theoretical and practical. Within recent years, hundreds of the products of vegetable and animal life have been built up from simpler compounds. Thousands of valuable dye-colors and other compounds used in the arts attest its practical value. It may, therefore, seem anomalous when I say that one of the most important of all the classes of organic compounds has not shared in this advance. The alkaloids, that most important class from a medical and pharmaceutical point of view, have until quite recently been defined in the books simply as “vegetable bases, containing nitrogen.” Whether they were marsh-gas or benzol derivatives was not made out; how the four elements, carbon, hydrogen, oxygen, and nitrogen, were grouped together in them was absolutely a thing unknown. Chemists all admitted two things—first, that their constitution was very complex, and, second, that the synthesis of any of the more important medicinal alkaloids would be an eminently desirable thing to effect from every point of view. Within the last five years, however, quite considerable progress has been made in arriving at a clearer understanding of these most important compounds, and I shall offer to your attention this evening a brief statement of what has been done and what seems likely to be accomplished in the near future.

It was early recognized that the alkaloids were complex amines or ammonia derivatives. The more or less strongly marked basic character of these bodies, the presence of nitrogen as an essential element, and, above all, the analogy shown to ammonia in the way these bases united with acids to form salts, not by replacement of the hydrogen of the acid, but by direct addition of acid and base, pointed unmistakably to

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this constitution. But with this granted, the simplest alkaloid formulas, those of conine, $C_8H_{17}N$, and nicotine, $C_{10}H_{14}N_2$, still showed that the amine molecule contained quite complex groups of carbon and hydrogen atoms, and the great majority of the alkaloids—the non-volatile ones—contained groups in which the three elements, carbon, hydrogen, and oxygen, all entered. Hence the difficulty in acquiring a knowledge of the molecular structure of those alkaloids at all comparable with that attained in the case of other organic compounds. Of course synthesis could not be applied until analysis had revealed something of the molecular grouping of these compounds, so the action of different classes of reagents was tried upon the alkaloids. Before summarizing the results of this study of the decomposition and alteration products of the alkaloids, a brief reference to a related class of organic compounds will be of assistance to those unfamiliar with recent researches in this field.

It is well known that in coal-tar is found a series of ammonia-like bases, aniline or amido-benzol, toluidine or amido-toluol, and xylidine or amido-xylol, which are utilized practically in the manufacture of the so-called aniline dye-colors. It is perhaps not so well known that there are other series of bases found there too. The first of these is the pyridine series, including *pyridine*, C_5H_5N , *picoline* (methyl-pyridine), $C_5H_4N(CH_3)$, *lutidine* (dimethyl-pyridine), $C_5H_5N(CH_3)_2$, and *collidine* (trimethyl-pyridine), $C_5H_2N(CH_3)_3$. This series is also found in relatively larger proportion in what is known as Dippel's oil, the product of the dry distillation of bones.

The second series is the quinoline series, including *quinoline*, C_9H_7N , *lepidine* (methyl-quinoline), $C_{10}H_9N$, and *cryptidine* (dimethyl-quinoline), $C_{11}H_{11}N$. The two compounds which give name to these series, pyridine, C_5H_5N , and quinoline, C_9H_7N , respectively, bear to each other a relation analogous to that existing between benzol, C_6H_6 , and naphthalene, $C_{10}H_8$; and the theory generally accepted by those chemists who have been occupying themselves with these bases and their derivatives is that pyridine is simply benzol, in which an atom of nitrogen replaces the triad group, CH, and quinoline, the naphthalene molecule with a similar change. Indeed, Ladenberg has recently succeeded in obtaining benzol as an alteration product from pyridine, in certain reactions. Moreover, from methyl-pyridine, $C_5H_4N(CH_3)$, would be derived an acid known as pyridine-carboxylic acid, $C_5H_4N(COOH)$, just as benzoic acid, C_6H_5COOH , is derived from methyl-benzol, $C_6H_5CH_3$, and from dimethyl-pyridine, $C_5H_3N(CH_3)_2$, an acid known as pyridine-dicarboxylic acid, $C_5H_3N(COOH)_2$, just as phthalic acid, $C_6H_4(COOH)_2$, is derived from dimethyl-benzol, $C_6H_4(CH_3)_2$. The same thing applies to quinoline as compared to naphthalene.

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We may now look at the question of the decomposing effect of reagents upon the alkaloids. The means which have proved most efficacious in decomposing these bases are the action of oxidizing and reducing agents, of bromine, of organic iodides, of concentrated acids and alkalies, and of heat.

Taking up the volatile alkaloids, we find with regard to *conine*, first, that the action of methyl iodide shows it to be a secondary amine, that is, it restrains only one replaceable hydrogen atom of the original ammonia molecule. Its formula is therefore $C_8H_{16}NH$. From conine can be prepared methyl-conine, which also occurs in nature, and dimethyl-conine. From this latter has been gotten a hydrocarbon, C_8H_{14} , conylene, homologous with acetylene, C_2H_2 . Conine, on oxidation, yields chiefly butyric acid, but among the products of oxidation has been found the pyridine carboxylic acid before referred to. The formula of conine, $C_8H_{17}N$, shows it to be homologous with piperidine, $C_5H_{11}N$, a derivative of piperine, the alkaloid of pepper, to be spoken of later; and, just as piperidine is derived from pyridine by the action of reducing agents, so conine is probably derived from a propyl-pyridine. The artificial alkaloid paraconine, isomeric with the natural conine, will be referred to later.

Nicotine, $C_{10}H_{14}N_2$, the next simplest in formula of the alkaloids, is a tertiary base, that is, contains no replaceable hydrogen atoms in its molecule. It shows very close relations to pyridine. When nicotine vapor is passed through a red-hot tube, it yields essentially collidine, and, with this, some pyridine, picoline, lutidine, and gases such as hydrogen, marsh-gas, and ethylene. Heated with bromine water to 120 deg.C. it decomposes into bromoform, carbon dioxide, nitrogen, and pyridine. When its alcoholic solution is treated with ferricyanide of potassium it is oxidized to dipyridine, $C_{10}H_{10}N_2$. Potassium permanganate, chromic or nitric acid oxidises it to nicotinic acid, $C_6H_5NO_2$, which is simply pyridine-carboxylic acid, $C_5H_4N(COOH)$, and which, distilled over quick-lime, yields pyridine, C_5H_5N .

Turning now to the non-volatile and oxygenized bases, we take up first the opium alkaloids. *Morphine*, $C_{17}H_{19}NO_3$, is a tertiary amine, and appears to contain a hydroxyl group like phenols, to which class of bodies it has some analogies, as is shown in its reaction with ferric chloride. Its methyl ester, which can be formed from it, is *codeine*, one of the accompanying alkaloids of opium. Besides the methyl derivative, however, others are possible, and several have been recently prepared, giving rise to a class of artificial alkaloids known as *codeines*. Morphine, rapidly distilled over zinc dust, yields phenanthren, trimethyl-amine, pyrrol, pyridine, quinoline, and other bases. The action of strong hydrochloric acid upon morphine changes it into apomorphine, $C_{17}H_{17}NO_2$, by the withdrawal of a molecule of water. Ferricyanide of potassium and caustic soda solution change morphine into oxidimorphine, $C_{34}H_{36}N_2O_6$. When heated with strong potassium hydrate, it yields methylamine.

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Narcotine, another of the opium alkaloids, when heated with manganese dioxide and sulphuric acid, is oxidized and splits apart into opianic acid, $C_{10}H_{10}O_5$, and cotarnine, $C_{12}H_{13}NO_3$. This latter, by careful oxidation, yields apophyllenic acid, $C_8H_7NO_4$, and this, on heating with hydrochloric acid to 240 deg. C., yields pyridine-dicarboxylic acid, $C_5H_9N(COOH)_2$. The base cotarnine also results from the prolonged heating of narcotine with water alone. In this case, instead of opianic acid, its reduction product meconine, $C_{10}H_{10}O_4$, is produced.

Meconic acid, $C_7H_4O_7$, which is found in opium in combination with the different bases, has also been investigated. By acting upon meconic acid with ammonia, comenamic acid is formed, and this latter, when heated with zinc dust, yields pyridine.

If we go now to the cinchona alkaloids, we meet with exceedingly interesting results. *Quinine*, $C_{20}H_{24}N_2O_2$, when carefully oxidized with chromic acid or potassium permanganate, yields a series of products. First is formed quitenine, $C_{19}H_{22}N_2O_4$, a weak base, then quininic acid, $C_{11}H_9NO_3$, then the so-called oxycinchomeric acid, $C_8H_5NO_6$, and finally cinchomeric acid, $C_7H_6NO_4$. Now the two acids last mentioned are simple substitution products of pyridine, oxycinchomeric acid being a pyridine-dicarboxylic acid, $C_5H_2N(COOH)_3$, and cinchomeric acid, a pyridine-dicarboxylic acid, $C_5H_3N(COOH)_2$. When distilled with potassium hydrate, quinine yields quinoline and its homologues. The alkaloid has been shown to be a tertiary base.

Quinidine yields with chromic acid the same decomposition products as quinine.

Cinchonine, $C_{19}H_{22}N_2O$, the second most important alkaloid of these barks, when oxidized with potassium permanganate, yields cinchonic acid, which is a quinoline-carboxylic acid, $C_9H_6N(COOH)$, cinchomeric acid, which has just been stated to be a pyridine dicarboxylic acid, and a pyridine tricarboxylic acid. When cinchonine is treated with potassium hydrate, it is decomposed into quinoline and a solid body, which on further treatment yields a liquid base, C_7H_9N , which is probably lutidine. It has been found, moreover, that both tetrahydroquinoline and dihydroquinoline, hydrogen addition products of quinoline, are present. When cinchonine is distilled with solid potassium hydrate, it yields pyrrol and bases of both the pyridine and quinoline series.

Cinchonidine, when heated with potassium hydrate, yields quinoline also, and with nitric acid the same products as cinchonine.

Strychnine has been found to be a tertiary amine. When distilled with potassium hydrate, quinoline is formed.

Brucine is a tertiary diamine, that is, formed by substitution in a double ammonia molecule. When distilled with potassium hydrate it yields quinoline, lutidine, and two isomeric collidines.

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The alkaloid *atropine* has been quite thoroughly studied with results of great interest. When heated with baryta-water or hydrochloric acid, it takes up a molecule of water and is split into tropine, $C_8H_{15}NO$, and tropic acid, $C_9H_{10}O_3$. This latter is phenyl-oxypropionic acid. Tropine, when heated to 180 deg.C. with concentrated hydrochloric acid, splits off a molecule of water, and yields tropidine, $C_8H_{13}N$, a liquid base, with an odor resembling conine. When this tropidine is heated with an excess of bromine, it yields dibromopyridine.

Piperine, the alkaloid of pepper, has also been well studied. When boiled with alcoholic potash solution, it takes up a molecule of water and splits apart into piperic acid, $C_{12}H_{10}O_4$, and piperidine, $C_5H_{11}N$. This latter base has been shown to be a hydrogen addition product of pyridine, C_5H_5N . When heated with concentrated sulphuric acid, it is oxidized to pyridine. Piperidine hydrochlorate, also, when heated with excess of bromine to 180 deg. C., yields dibromopyridine.

Sinapine, the alkaloid which exists as sulphocyanate in white mustard seed, yields, under the same reaction as that applied to atropine and piperine, quite different results. When boiled with baryta water, sinapine decomposes into sinapic acid, $C_{11}H_{12}O_5$, and choline, $C_5H_{15}NO_2$, the latter a well-known constituent of the bile, and produced also in the decomposition of the lecithin of the brain and yolk of egg.

Cocaine, the alkaloid of coca leaves, is decomposed by heating with hydrochloric acid into methyl alcohol, benzoic acid, and a crystalline base, ecgonine, $C_9H_{15}NO_3$.

Caffeine and *theobromine* have also quite different relations. Caffeine, it will be remembered, is the methyl ester of theobromine, and can be prepared from it. When caffeine is carefully oxidized with chlorine, it yields dimethyl-alloxan and methyl-urea. Both theobromine and caffeine are decomposed by heating to 240 deg. C. in sealed tubes with hydrochloric acid, identical products being obtained. These products are carbon dioxide, formic acid, ammonia, methyl-amine, and sarcosine, the last three being of course in combination with the excess of hydrochloric acid. The artificial preparation of theobromine and caffeine from xanthine, and guanine also show clearly their relations.

If, having completed our survey of what has been done in the way of decomposing the alkaloids by the different classes of reagents, we review the field, it will be seen that with all the alkaloids mentioned, except the last four, a more or less immediate connection with the pyridine and quinoline bases has been indicated. The conviction accordingly forces itself upon us that, if we want to attack the problem of building up any of these important alkaloids artificially, we must turn to these bases as our starting point.

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As already stated, both series occur in coal-tar and the pyridine series also more abundantly in bone-oil. Pyridine, picoline, lutidine, and collidine, the first four members of the pyridine series, have, moreover, all been formed synthetically, although the processes are not such as would yield the products as cheaply as they can be gotten from Dippel's oil. Quinoline, the first member of the higher series, had been made synthetically by several chemists, but by expensive and involved methods, when Skraup, in 1881, effected its synthesis from nitrobenzol and glycerin, or still better, a mixture of nitrobenzol and aniline with glycerin. This process allows of its being made on a commercial scale if desirable. Shortly after, by an application of the same principle, Dobner and Miller effected the synthesis of lepidine, the second member of the quinoline series.

At the same time that this general agreement to consider these bases as the starting point in the endeavor to effect the synthesis of the natural alkaloids had been arrived at by chemists, it was thought well to look into the question whether these bases and their immediate derivatives had any therapeutic value of their own.

Piperidine, the decomposition product of piperine, which we have shown may be considered to be hexahydropyridine, was examined by Dr. Kronecker, of Berlin, at the request of Prof. Hofmann, and was found to have an action upon animals in many respects resembling that of conine. Prof. Filehne, of Erlangen, who has studied a large number of these pyridine and quinoline derivatives, found, moreover, that the hydrochlorate of ethyl-piperidine had a physiological action quite analogous to that of conine.

The physiological action of quinoline itself has been studied quite extensively by Donath and others, and it was found that several of its salts were quite valuable febrifuges, acting very like quinine, and capable in cases of being used as a substitute for it. In general, the hydrogen addition products were found to be more active than the simple base, an observation entirely in accord with the theory formed by Wischnegradsky, and by Konigs, as the result of the study of the decomposition products of the alkaloids, viz., the alkaloids are in general hydrogen addition products of pyridine and quinoline, or of the two bases combined. Thus Prof. Filehne found that hydrochlorate of tetrahydroquinoline was much more energetic in its action than quinoline, but could not be used on account of a too powerful local effect. The hydrochlorate of dimethyl-tetrahydroquinoline, which was distinguished by its strong bitter taste, much resembling that of quinine, had an effect like that of curare poison. The most decided febrifuge action, however was found by Prof. Filehne to reside in the hydrochlorate of oxyhydro-methyl-quinoline, introduced to public notice by Prof. O. Fischer under the name of "Kairin," and in the acid sulphate of tetrahydro-methylquinoline, introduced under the name of "Kairolin." These compounds had a very surprising febrifuge action, without any unpleasant after effects or local disturbances.

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The most active workers in the field of synthetic formation of the alkaloids have been Wischnegradsky, of St. Petersburg—who, unfortunately for science, died at an untimely age in 1880—Koenigs and Fischer, of Munich, and Ladenburg, of Kiel. The study of the decomposition products of the cinchona alkaloids especially points quite distinctly to the probable existence in quinine of a hydrogen addition product of pyridine, in combination with a methyl-quinoline group. The many experiments that are now being made to test this and other questions that suggest themselves, will not long leave us in the dark. Whether a practical commercial synthesis of quinine will follow is another matter, but it is within the bounds of possibility, or perhaps even of probability.

It must not be supposed that no syntheses of alkaloids have been effected as yet. By heating butyl-aldehyde with alcoholic ammonia is formed *paraconine*, an alkaloid isomeric with the natural conine, but differing in physiological action. By the action of sodium upon pyridine is produced a compound $C_{10}H_8N_2$, known as dipyridyl, and this, under the influence of nascent hydrogen, takes up six atoms and becomes *isonicotine* $C_{10}H_{14}N_2$, a physiologically active alkaloid, isomeric with the true nicotine. The formation of a series of alkaloids under the name of *codeines*, by the substitution of other organic radicals instead of methyl in the codeine reaction, has already been alluded to. *Atropine* can be formed by uniting tropine and tropic acid, the two decomposition products already noted. The latter of these products is already shown to be capable of synthetical formation, and the other will no doubt be formed in the same way. The artificial atropine is identical with the natural alkaloid. Ladenburg has also formed a series of artificial alkaloids, called *tropeines*, by uniting the base tropine with different organic acids, as in the case of the compound of mandelic acid and tropine, known as *homatropine*, an alkaloid of action similar to atropine, but possessing some decided advantages in its use. *Piperine* has also been made by the uniting of piperidine and piperic acid, and, as piperidine has already been formed from pyridine, we have here a true synthesis also. Both *theobromine* and *caffeine*, its methyl derivative, have been made from xanthine, which itself can be formed from guanine, a constituent of guano.

We may conclude from this reference to what has been done in the last few years, that the reproach mentioned in first speaking of the alkaloids as a class, that almost nothing was known of their constitution, will not long remain, and that as their molecular structure is laid bare in these studies now being made, keen-sighted chemists will effect their artificial formation. When these most valuable compounds can be made by exact methods, in a state of entire purity, and at a cost much below that paid for the present extraction of them from relatively rare plants, organic chemistry will have placed all of us under obligations as great as those owing any branch of science, no matter how practical we call it.—*Amer. Jour. of Pharmacy*.



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ON THE TREATMENT OF CONGESTIVE HEADACHE.

By J. LEONARD CORNING, M.D., New York.

If we examine the literature of our theme, we are astounded by the apparently hopeless confusion in which the whole is involved. Everywhere attempts at ill-founded generalization are encountered. We are compelled to admit, after perusing long debates in regard to the relative merits of various therapeutic measures, that those who were foremost to disparage the treatment pursued by others were totally ignorant of the fact that those same symptomatic manifestations which they were considering might be owing to entirely different causes from similar conditions described by others. Hence a commensurate modification in therapy might not only be admissible, but eminently desirable. It is more especially of recent years that a laudable attempt to differentiate the various etiological factors involved in different forms of headache has been made. In 1832 Dr. James Mease, of Philadelphia published a monograph on "The Cause, Cure, and Prevention of the Sick Headache," which is substantially a treatise on the dietetics of this particular form of headache. The work, however, is conspicuously lacking in those philosophical qualities which are so necessary to a true understanding of the questions involved. Dr. E.H. Sieveking published in 1854[1] a most interesting paper on "Chronic and Periodical Headache." The views therein expressed are remarkable for their succinct and thoroughly scientific elucidation of the two great physiological principles involved in the consideration of by far the greater majority of instances of cephalalgia. I refer namely to the importance ascribed by this eminent physician to the fluctuations of the blood-stream within the cranial vault. In speaking of this subject Dr. Sieveking says: "Nothing is of more importance in reference to the pathology and therapeutics of the head than clear and well-defined notions on the physiological subject of the circulation within the cranium; for, among the various sources of medical skepticism, no one is more puzzling or more destructive of logical practice than a contradiction between the doctrine of physiology and the daily practice of medicine."

[Footnote 1: On Chronic and Periodical Headache, by E.H. Sieveking, M.D., *Medical Times and Gazette* London, August 12, 1854.]

What Dr. Sieveking said in 1854 holds equally good to-day; and, indeed, the position then taken has received substantial indorsement through the positive results of more recent experimental physiology. Conspicuous in this connection are the inductive researches of Durham, Fleming, and Hammond, touching the modifications in the cerebral circulation during sleep and wakefulness. By these experiments it has been conclusively proved that the amount of blood in the brain is decreased during sleep and increased during wakefulness.



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More, recently I have had occasion to confirm the experiments of Fleming in this direction, and have published the results of those researches in various papers and articles.[1] "What Hippocrates said of spasm," says Dr. Sieveking, "that it results either from fullness or emptiness, or, to use more modern terms, from hyperaemia or anaemia, applies equally to headache; but, to embrace all the causes of this affection we must add a third element, which, though most commonly complicating one of the above circumstances, is not necessarily included in them, namely a change in the constitution of the blood." While I agree with Dr. Sieveking as regards the importance to be ascribed to the first two factors—cerebral hyperaemia and anaemia, in the production of the group of symptoms known as "headache,"—I fail to perceive why especial prominence should be given to the third condition mentioned by Dr. Sieveking. Indeed, I am quite unable to imagine how the periodical, and more especially the intermittent form, of headache is to be explained by what Dr. Sieveking describes rather ambiguously as a "change in the constitution of the blood." It is quite evident, admitting that such a change is capable of producing an amount of cerebral irritation sufficient to develop well-marked cephalalgia, that the latter must of necessity be within certain limits continuous. This is not the case, as the causative factor is constant and not fluctuating. I am, therefore, not prepared to accept this third causative factor without question. Nevertheless I am perfectly willing to admit that other factors besides cerebral hyperaemia and anaemia may produce the functional variety of headache. There would seem to be ample ground for ascribing great causative importance to excessive irritation of the brain plasma itself. Hence those forms of headache which while, being unaccompanied by any especial circulatory derangements, succeed, oftentimes, with relentless regularity upon any considerable degree of mental work. It is not my purpose to discuss the treatment of the multifarious forms of cephalalgia on this occasion, did time permit. As regards the so-called "neuralgic" variety I content myself by referring to the admirable work on "Neuralgia and Kindred Diseases of the Nervous System," by Dr. John Chapman of London, in which will be found many interesting facts bearing on the question. Accepting the propositions, then, that the more adjacent causes of headache are (1) cerebral hyperaemia, (2) cerebral anaemia, and (3) irritation of the cerebral plasma itself, let us now consider how these morbid factors are most scientifically and speedily met at the bedside; and how, more particularly, those distressing conditions of engorgement, which are so baneful an item in the causation of a certain form of cephalalgia, are best overcome.

[Footnote 1: *Vide* Carotid Compression and Brain Rest, by J.L. Corning, M.D. New York: Anson D.F. Randolph & Co.]

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Two years ago I began a series of experiments on epileptics and maniacs, which involved the application of protracted pressure to the common carotid artery on both sides. In the course of these experiments the thought suggested itself that suppression of the carotids might prove a salutary means of reducing that form of cerebral congestion which is so prolific a source of headache and vertigo. Accordingly I made a protracted series of experiments with carotid compression upon those suffering from congestive headache, and I can only say that I have been so far pleased with the uniformly good results obtained, that I have felt it a duty to call the attention of the profession to a procedure which, for obvious reasons, possesses all the advantages of local depletion by leeching or cupping, without the manifest disadvantages of either of these methods. The instruments which I have devised as substitutes for the primitive procedure of digital compression of the carotids have already been described in former communications. It is only necessary to say that the implements in question are of two kinds; one, the "carotid fork," is an adjustable instrument, which being held in the hand of the operator permits him to exert any degree of pressure upon both carotids for any desired length of time. The other instrument, which I have designated as the "carotid truss," for lack of a better name, is a circular spring provided with adjustable pads at each extremity. The spring is placed about the neck of the patient, and by suitable appliances the pads at the extremities can be placed directly above the trunks of the two common carotid arteries. By turning the screws to which the pads are attached the desired amount of pressure can be applied to the arteries, and the apparatus can be worn for any length of time by the patient.

With these instruments I have frequently succeeded in arresting the most obstinate form of congestive headache in an incredibly short time (on one occasion in about five minutes). Where, however, the headache is of manifestly nervous origin and uncomplicated by any especial circulatory derangements, I have never been able to achieve notable results with this method. Indeed, pressure upon the carotids is an excellent method of differentiating the congestive form of headache from the nervous varieties of head pains.

Of galvanism this much may be said, that it is one of the most valuable methods which we possess for treating the form of headache under consideration, for not only does it cause contraction of the smaller arteries, but it also exerts a soothing influence upon the plasma of the brain itself.

A powerful therapeutic agent, and one which has been more or less extensively employed in the treatment of various forms of head and spinal symptoms, is cold.



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A very excellent method of applying both cold and galvanism to the head, at the same time, is afforded by a species of refrigerating electrode, designed by myself for this purpose. The apparatus in question consists of a concave sponge electrode, the concavity of which corresponds to the convexity of the external aspect of the cranium. Above the electrode is a chamber of metal or India-rubber, designed to contain ice. The whole is secured to the head of the patient by a single chin-strap, and connection established with an ordinary galvanic battery by means of an appropriate clamp and insulated cord. The indifferent pole is applied over the sternum or other convenient point. Care should be taken not to employ too strong currents, as otherwise vertigo and other unpleasant symptoms may be produced. An application of from five to ten minutes is usually sufficient to arrest the head-pain. As an additional security it is well to recommend the patient to take a hot foot-bath, and to remain as quiet as possible for twelve hours succeeding the treatment. In hyperaemic headache cupping and blood-letting have been recommended; but as a rule both procedures are not only unnecessary but positively inadmissible, as exclusion of the superfluous amount of blood by compression upon the carotids, followed by a corresponding dilatation of the peripheral circulation by means of the foot-bath, will almost always be sufficient to cause a permanent cessation of the symptoms. Among the internal remedies which may be employed with good effect in certain cases are aconite, bromide of potassium, and Indian hemp. The inhalation of from five to ten drops of chloroform is an excellent expedient in some instances. Chlorodyne, which is nothing more than a mixture of sedatives, often works well, and indeed frequently excels other remedies. The regulation of the heart's action is also of very great importance in these cases, and the physician should have no hesitancy in resorting to such remedies as digitalis and belladonna for the purpose of reducing the tension in the domain of the cerebral circulation. As a matter of course the digestive functions should be carefully looked to; the bowels should be kept open; and in all cases where there are indications of a congestive origin, alcohol in all forms should be absolutely forbidden.—*Med. Record.*

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THE USE OF THE MULLEIN PLANT IN THE TREATMENT OF PULMONARY CONSUMPTION.

[Footnote: From a paper published in the *British Medical Journal*.]

By F.J.B. QUINLAN, M.D., M.R.I.A., F.K.Q.C P., Physician to St. Vincent's Hospital, Dublin.



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From time immemorial, the *Verbascum thapsus*, or great mullein, has been a trusted popular remedy, in Ireland, for the treatment of the above formidable malady. It is a wild plant—most persons would call it a weed—found in many parts of the United Kingdom; and, according to Sowerby's *British Botany*, vol. vi., page 110, is "rather sparingly distributed over England and the south of Scotland." In most parts of Ireland, however, in addition to growing wild it is carefully cultivated in gardens, and occasionally on a rather extensive scale; and this is done wholly and solely in obedience to a steady popular call for the herb by phthysical sufferers. Constantly, in Irish newspapers, there are advertisements offering it for sale; and there are, in this city, pharmaceutical establishments of the first rank in which it can be bought. Still it does not appear in the Pharmacopoeia; nor, as far as I know, has its use received the official sanction of the medical profession. Some friends with whom I talked over the matter at the Pharmaceutical Conference at Southampton last August, suggested that it would be desirable to make a therapeutical research into the powers of this drug, and ascertain by actual experiment its efficacy or otherwise. Having partially accomplished this, I am anxious to very briefly set forth what has been done, in order that others may be induced to co-operate in the work.

"There are five mulleins, all belonging to the parent order of the Scrophulariaceae; but the old Irish remedy is the great mullein, or *Verbascum thapsus*, a faithful delineation of which will be found in Plate 1, 437, vol. vi., of Sowerby. It is a hardy biennial, with a thick stalk, from eighteen inches to four feet high, and with very peculiar large woolly and mucilaginous leaves, and a long flower spike with ugly yellow and nearly sessile flowers. The leaves are best gathered in late summer or autumn, shortly before the plant flowers. In former times it appears to have been rather highly thought of, particularly as a remedy for diarrhoea; and Dioscorides, Culpepper, and Gerarde favorably allude to it.

"Having been furnished with a good supply of fresh mullein from a garden near this city, where it is extensively grown, I commenced operations. As it proved useful, subsequent supplies were procured from our drug-contractor.

"The old Irish method of administering the mullein is to place an ounce of dried leaves, or a corresponding quantity of the fresh ones, in a pint of milk; to boil for ten minutes, and then to strain. This strained fluid is given warm to the patient, with or without a little sugar. It is administered twice a day; and the taste of the mixture is bland, mucilaginous, comforting to the praecordia, and not disagreeable. I resolved to try this method, and also the watery infusion; and, moreover, the natural expressed juice fortified with glycerin. This latter preparation was carefully made for me, from fresh mullein leaves, by Dr. John Evans, chemist to the Queen and the Prince of Wales.



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“Some phthisical sufferers, of whom there are here, alas! too many, were now admitted from time to time into St. Vincent’s Hospital. They were admitted in all stages, from an early one to the most advanced. On each admission the case was carefully examined; the history, symptoms, and physical signs were exactly noted; and the patient was weighed on a stage balance with great accuracy. The patient was put as much as possible on the mullein treatment only. For obvious reasons, no cod-liver oil, koumiss, or other weight producer was given; the patients got the diet suitable to such sufferers; and, if the special symptoms became troublesome, received appropriate treatment. As much as possible, however, they were left to the mullein—a proceeding which was entirely satisfactory to themselves. In addition to the admission weighing, they were carefully weighed every week, and care was taken that this should be done as nearly as possible on the same day and hour, with the same clothes, and, in fact, as much as could be under the same conditions. In securing this the patients anxiously co-operated; and it was frequently amusing, but sometimes painful, to watch the satisfaction or chagrin with which the weekly result was received. I must here tender my acknowledgments to our zealous, attentive, and accurate house surgeon, Mr. Denis P. Kenna, by whom this important, but tedious, duty was discharged.”

Dr. Quinlan then refers to several cases, in which the mullein plant has been tried as a remedy for consumption, and remarks that these cases, although too few to justify any general conclusion, appear to establish some useful facts. The mullein plant boiled in milk is liked by the patients; in watery infusion it is disagreeable, and the succus is still more so. The hot milk decoction causes a comfortable (what our Gallic neighbors call *pectorale*) sensation, and when once patients take it they experience a physiological want, and when the supply was once or twice interrupted, complained much in consequence. That it eases phthisical cough there can be no doubt; in fact, some of the patients scarcely took their cough mixtures at all—an unmixed boon to phthisical sufferers with delicate stomachs. Its power of checking phthisical looseness of the bowels was very marked, and experiment proved that this was not merely due to the well known astringent properties of boiled milk. It also gave great relief to the dyspnoea. For phthisical night sweats it is utterly useless; but these can be completely checked by the hypodermic use of from one-eighteenth to one-fiftieth of a grain of the atropia sulphate; the smaller dose, if it will answer, being preferable, as the larger causes dryness of the pharynx, and interferes with ocular accommodation. In advanced cases, it does not prevent loss of weight, nor am I aware of anything that will, except koumiss. Dr. Carrick, in his interesting work on the koumiss treatment of Southern Russia (page 213), says:



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“I have seen a consumption invalid gain largely in weight, while the disease was making rapid progress in her lungs, and the evening temperature rarely fell below 101 deg. Fahr. Until then I considered that an increase of weight in phthisis pulmonalis was a proof of the arrest of the malady.” If koumiss possesses this power, mullein does not; but unfortunately, as real koumiss can be made from the milk of the mare only, and as it does not bear traveling, the consumptive invalid must go at least to Samara or Southern Russia. In pretubercular and early cases of pulmonary consumption, mullein appears to have a distinct weight-increasing power; and I have observed this in several private cases also. Having no weighings of these latter, however, makes this statement merely an expression of opinion. In early cases, mullein milk appears to act very much in the same manner as cod-liver oil; and when we consider that it is at once cheap and palatable it is certainly worth a trial. I will continue the research by careful weighings of early cases; and will further endeavor to ascertain whether the addition of mullein to the cultivating solution prevents the propagation of the phthisical bacillus.

* * * * *

ACTION OF MINERAL WATERS AND OF HOT WATER UPON THE BILE.

Lewaschew and Klikowitch, from experiments upon dogs, conclude that the use of ordinary alkaline mineral waters was to increase the quantity of bile and to make it more fluid and watery. This increased flow is beneficial in clearing out any bile stagnating in the gall-bladder. A subsequent increase in the quantity of bile indicates a greater flow of bile into the gall-bladder, and this also is of service in emptying out any stagnant bile, and restoring the normal condition when this is disturbed. Artificial solutions of alkaline salts were found to have a similar action to the natural mineral waters, and, as with them, the action varies according to the concentration of the solution. Bicarbonate of sodium has a quicker, more powerful, and more lasting effect on the composition of the bile than the sulphate of sodium, and weak solutions than strong ones. Vichy was more efficacious than Carlsbad water. Hot water was found to have an effect on the bile much like that of the mineral waters.

* * * * *

VIVISECTION.

Although Magendie is rightly considered the true initiator of experimentation upon living beings, the practice of vivisection is as old as science itself.



Galen, the physician of Marcus Aurelius (in the second century of the Christian era), dissected living animals, and yet he is regarded as having merited his name (*Galenus*, "gentle") from the mildness of his character. Five centuries before him, under the Ptolemies, Egyptian experimenters had operated upon condemned persons. So, then, vivisection is not, as usually thought, a diabolical invention of modern science.

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[Illustration: Fig. 1-5 APPARATUS USED IN VIVISECTION.]

In all ages the necessity has been recognized of operating upon animals that are nearest allied to man, such as the monkey, the hog, and the dog, and who share with the king of creation the privilege of eating a little of everything. Claude Bernard, however, had another way of looking at things. It is true that he especially made researches into the general laws of physiology, the secret of the vital functions, and the operation of the various organic systems that constitute living matter, but his immediate object was not to furnish weapons for the art of curing. He left to physicians and surgeons the care of drawing conclusions from his great work in biology, and of acting experimentally upon animals allied to man in order to found a rational system of therapeutics. So he preferred to operate upon beings placed low in the animal scale—the frog especially, an animal that has rendered him greater service than even man himself could have done. Cold-blooded animals offer, moreover, the advantage of being less impressionable than others, and the experiments to which they are submitted present more accurate conclusions, since it is not necessary to take so much account of the victim's restlessness. And then it is necessary in many cases to choose subjects that possess endurance. The unfortunate frog, so aptly named "the Job of physiology," becomes resigned to living under most dreadful conditions, and when, through sheer exhaustion, he has succumbed, his twitching limbs may still be used as an object of experimentation for twenty-four hours. Thanks are due to nature for giving so extraordinary a vitality to the tissues of a modest batrachian! We owe to it the famous experiment of Galvani that led Volta to the discovery of the pile and what followed it, the astonishing conquests of electricity and those more marvelous ones still that are now in their dawn. Science is much indebted to the frog, and may the homage that we pay him help to alleviate the sufferings that have been imposed upon this brave animal!

[Illustration: Fig. 6-8 APPARATUS USED IN VIVISECTION.]

The simple fact that we have just enunciated pleads loudly enough for the cause of vivisection to make it useless to defend it. No one, however, has risen to ask for an absolute proscription of it, but it is only desired that the abuse of an abominable practice shall be curbed. Does the abuse exist? That is the question, and it may be answered in the affirmative. Yes, we do sometimes impose useless sufferings upon animals. It is a culpable folly, a beastly cruelty, to constantly repeat barbarous experiments with the object of exhibiting a well known physical fact, a hundred times verified and always the same, when it would only be necessary to enunciate it. But this is not the place to expatiate upon the subject. After proclaiming the utility of vivisection, we give it as our opinion that the practice of it should be confined within narrow limits. It is not too much to ask that it be confined to the privacy of laboratories, with the exclusion of visitors, and to require from students a diploma guaranteeing their knowledge and giving a programme of researches to be made. It is useless to seek in the living what a study of the corpse reveals in all its details.

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[Illustration: Fig. 9-11 APPARATUS USED IN VIVISECTION.]

And now, after these preliminary remarks, we present herewith a series of cuts representing the various apparatus used in the practice of vivisection, which are taken from a recent work by Claude Bernard. Fig. 1 shows the mode of muzzling a dog with a strong cord placed behind an iron bit. Fig. 2 shows a method of tying a dog. Fig. 3 is a vessel in which hares or cats are placed in order to anaesthetize them. Fig. 4 shows the mode of fixing an animal on its side, and Fig. 5 the mode of fixing him on his back. Fig. 6 shows a dog fixed upon the vivisecting table, and Fig. 7 a hare secured to the same. Fig. 8 exhibits the general arrangement of a vivisecting table, properly so called. Fig. 9 shows (1) an anaesthetizing muzzle applied to a dog, and (2) the extremity of the apparatus in section. Fig. 10 shows how the muzzle is applied for anaesthetizing, and gives the details of construction of the chloroform box. Fig. 11 exhibits the arrangement of the apparatus used for holding the animal's jaws open upon the vivisecting table.—
L'illustration.

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INSANITY FROM ALCOHOL.

[Footnote: Read at the late meeting of the National Association for the Protection of the Insane and translated for the American Psychological Journal by Carl Sieler, M.D., of Philadelphia.]

By A. BAER, M.D., of Berlin, Germany.

The benevolent efforts of your society diverge in two different directions, which have totally different aims and purposes, and which require different means in order to attain lasting success. Since the number of insane has increased alarmingly within the last few years, in all civilized countries, so that the responsibility of the proper charge of them occupies continually not only the community, but also the State; and since the public as well as the private asylums are filled almost before they are finished, it becomes necessary to rid the institutions, as soon as possible, of those patients which have been cured, as well as of those which are improved. Patients of this kind are, as early as possible, returned to the unrestrained enjoyment of liberty with the expectation that the new scenes and surroundings may have a beneficial influence, besides having the advantage of relieving the overcrowded institutions. Unfortunately, however, it has been frequently found that the hut suddenly restored mental and emotional equilibrium is not of sufficient stability to withstand the storm of conflicting interests. Frequently it happens that the but recently discharged patient returns to the institution, after a short lapse of time, because the "rudder" (steuer) of his intelligence was soon shattered in the turmoil of life. How can, for instance, the indigent and poor patient, after his discharge from the institution in which he has found a shelter and the proper care, stand up in the



struggle for existence and the support of his family? Is it not to be expected that a large proportion of those who have been discharged as improved, or even cured, cannot withstand the ever-moving sea of the outside life and bear up under the turmoil which constantly stirs mind and soul?

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Starting with the recognition of this fact, societies of benevolent people have been formed in all countries in which true civilization and humanity are at work, to diminish or abolish social evils, whose object is to assist the restored patient who has been discharged from the institution, at a time when he is most in need of help and assistance. Switzerland has taken the lead of all countries by her brilliant example, and there these societies found the greatest encouragement. It should be looked upon as a good sign of the spirit of modern times, that the seed of true humanity, with astonishing rapidity, found its way, far and wide, for the benefit of suffering mankind. Everywhere, in all European countries, and also on the American continent, has this branch of a truly noble thought become acclimated, and many societies have been organized for the purpose of assisting cured insane patients, by aiding them in obtaining suitable occupations, or by direct donations of money, *etc.*, with a view of preventing, if possible, a relapse of the disease. May this portion of the work of your society be an ever-flowing fountain of joy and satisfaction to your members!

Of much greater importance is the best portion of your work, namely, *the prevention of insanity*. It is nevertheless true, and cannot be doubted, that in all civilized countries insanity increases in a manner which is out of proportion to the increase of the population. Much thought has been given to the cause of this phenomenon, and physicians as well as moralists, national economists as well as philosophers and philanthropists, have endeavored to fathom the connection between this fact and the conditions of modern social life. According to all observations, it is certain that the cause of this phenomenon is not a single etiological condition, but that it is the sum of a number of influences which act upon the human race and produce their travages in the mental and moral life of our patients. The conditions which give rise to this increase of insanity may be looked for in the manner in which modern civilization influences mankind, in its development and culture, in the family and in the school-room, in its views of life and habits; also in the manner in which civilization forces a man to fight a heavier and harder battle for pleasure and possessions, power and knowledge, and causes him to go even beyond his powers of endurance.

More than even civilization itself, are at fault those pernicious abnormalities, rare monstrosities, which are transmitted from generation to generation, or are also often newly developed and appear to belong to our civilization. If we want to prevent the increase of insanity, we must endeavor to do away with these monstrosities and eccentricities from our social life which remove mankind more and more, in a pernicious manner, from its natural development and from the normal conditions of moral and physical life; we must endeavor to kill these poisonous offshoots



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of pseudo civilization, which are the enemies of the normal existence of man. It is necessary to liberate the individual, as well as the entire society of modern times, from the potentiated egotism which spurs man on in overhaste, and in all departments of mental and physical life, to a feverish activity, and then leads to an early senile decay of both body and mind; from that terrible materialism which causes the modern individual in every class of society to find satisfaction in over excited taste and ingenious luxury. It is necessary to strengthen more than has been done heretofore the young, by means of their education, in their physical development, and at the same time to diminish, in proper proportion, the amount of mental over-exertion; and finally it is necessary to fight against, to do away with, those habits of modern society-life which have a pernicious influence upon the physical as well as the mental and moral organization of man. And of these latter, there is none so lasting in its effects, none so harmful to the physical as well as moral life, as the abuse of intoxicating liquors.

Intemperance is an inexhaustible source of the development and increase of insanity. It demands our undivided attention, not only on account of its existing relation, but particularly because intemperance, among all the factors which aid in the increase of insanity, can best be diminished, and its influence weakened, through the will of the single individual, as well as of society as a whole. The relation between intemperance and insanity is so definite and clear, that it is not necessary to adduce proofs of this fact. I will not refer to the writings of the older authors, such as Rush, in America; Hutchison, Macnish, Carpenter, and others, in England; Huss and Dahl, in Sweden; Ramaer, in Holland; Esquirol, Pinel Brierre de Boismont, Morel, and others, in France; Flemming, Jameson, Roller, Griesinger, and others, in Germany. I could name a much larger number of the greatest modern authorities on insanity, who are all unanimous in their opinion that the increase of intemperance (alcoholism) produces a corresponding increase of insanity. Of especial interest is this fact in those countries in which the consumption of concentrated alcohol, and particularly in the form of whiskies distilled from potatoes and corn, has only in later years become general. Thus Lunier has shown the number of alcoholic insane increased by ten per cent. in those departments in which more whisky and less wine is consumed.

In Italy a similar result has been reached by investigation; and in that country (according to Kanti, Sormani, Vesay, Rareri, Castiglione, Ferri, and others) the frequency of insanity caused by the abuse of alcohol stands in an unmistakable relation to the consumption of alcohol in certain provinces of Italy.



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In a discussion at one of the meetings (1876) of the London Medico-Psychological Society, the general opinion of the members was, that intemperance is the most fruitful source of the increase of insanity, even when no other etiological element could be found, and alcohol had to be looked upon as the sole cause of the mental disease. Maudsley laid especial stress upon the observation, that intemperance, without hereditary predisposition, was one of the most powerful agencies in the production of aberration of the mind. Even Beckwith, who could not coincide with others as to the great importance of intemperance as an etiological element, says distinctly, that intemperance was, by far, the most potent of all removable causes of mental disease.

In comparing the number of drinking saloons in the different provinces of the kingdom of Prussia with the number of insane, both in public institutions and in private families, as gleaned from the census report of 1871, I was enabled to show conclusively, that everywhere, where the number of drinking places, *i.e.*, the consumption of alcohol, was greatest, the number of insane was also largest. Without doubt, to my mind it is in alcohol that we must look for and will find the most potent cause of the development and spread of mental diseases.

As is well known, alcohol acts as a disturbing element upon the nerve centers, even if it has only once been imbibed in excessive quantity. In consequence of the acute disturbance of circulation and nutrition an acute intoxication takes place, which may range from a slight excitation to a complete loss of consciousness. After habitual abuse of alcohol, the functional disturbances of the brain and spinal cord became constant and disappear the less, as in the central organs degenerative processes are more and more developed, processes which lead to congestions and hemorrhagic effusions in the meninges and in the brain itself, to softening or hardening, and finally to disappearance of the brain substance. These degenerations of the nervous system give rise to a progressive decay of all intellectual and also, more especially, of the ethical functions, a decay which presents the phenomena of feeble mindedness, complicated with a large number of sensational and motor disturbances, and gradually ends in complete idiocy.

The number of those mental disturbances which are caused by alcohol intoxication is a very considerable one. We do not err if we assert that from 20 to 25 per cent. of all mental diseases stand in a direct or indirect relation to the evil consequences of intemperance in the use of intoxicating liquors. This is the opinion of a large number of authorities on mental diseases in all countries. Habitual intemperance leads to severe (psychical?) lesions (of the nervous system) which may show themselves in the different forms of insanity, but express themselves chiefly as mental weakness, not only in persons whose nervous system was weakened through inherited or acquired defects, but also in those whose mental organization was intact. In many other cases we see less complete forms of insanity and more indistinct psychological disturbances and neuroses, and among the latter epilepsy demands particular attention.



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An investigation among the patients in the insane department of the Berlin Charite Hospital, in charge of Prof. Westfahl, which was lately carried on by Dr. T. Galle (*Über die Beziehung des Alcoholismus zur Epilepsie. Inaug. Dissert. 1881, Berlin*), showed that among 607 patients who had entered the ward as epileptics or epileptic insane, 150 = 24.7 per cent. had been addicted to drink; 133 before, and 17 after the disease had shown itself; further, that of 1572 patients with delirium tremens, alcoholism, alcoholic dementia, and ebrietas, 243, or 15.4 per cent., were epileptic; and that in 221 intemperance was present before the outbreak of epilepsy; finally, that among 2679 patients which entered the department in six and a half years, 393, or 18 per cent., were inebriates and epileptics. Among 128 epileptics which I had occasion to note in the receiving institute, Plotseurie, 21 per cent. were drunkards and 20 per cent. were the offspring of intemperate parents.

If the list of injuries which intemperance, as we have seen, does directly to the mental life of man is a very considerable one, the baneful effect which is produced indirectly, by the intemperance of parents, upon the mental constitution of their progeny is surely just as great and disastrous. The children of intemperate parents frequently become drunkards themselves; they have inherited a degeneration of the vitiated constitution, and carry the stamp of this degeneration within themselves. The offspring of drunkards are not only weakly and sickly, and die early, especially of diseases of the brain, but, as Dahl, Morel, Howe, Beach, and others have shown, they are frequently born idiotic, or show early signs of insanity. Under the influence of alcohol, the individual constitution of the drinker becomes lowered and depraved, and, according to the law of inheritance, is transmitted through the progeny to the race.

Prof. Bollinger, the latest writer on inheritance of disease (Stuttgart, 1882—Cotta—*Über Dererbung von Krankheiten*), names alcoholism among the transient abnormal conditions which, during conception, exert their influence, so that children of intemperate parents acquire pathological, and especially neuro-pathological, dispositions. Intemperance, says this author, in its acute, as well as in its chronic form, causes frequently pathological changes in the nervous system, and thus may the pathological differences in children of the same parents be partially explained. On account of the inheritance of a depraved and pathological constitution, the children of intemperate parents frequently suffer from an abnormal psychical organization. As in the progeny of insane, epileptics, suicides, and criminals, so also among the children of drunkards, do we see cases of congenital idiocy and imbecility, of neurasthenia and inebriety, of psychical and somatic degeneracy, also of depraved morality, of vagrancy and crime.

Mr. President and Gentlemen: In the light of the enumerated facts, nobody will dispute that intemperance is a fruitful as well as inexhaustible source for the increase and development of insanity; and that every effort toward diminution of the frequency of insanity, toward the prevention of mental diseases, must be directed against this widespread evil, intemperance.



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May your noble society succeed in confining this torrent of evil in a narrower growing bed, and to deliver mankind from a curse which cannot be too much contended with.

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PLANTAIN AS A STYPTIC.

[Footnote: Read at the meeting of the Amer. Pharm. Assoc.]

By J.W. COLCORD.

Several articles during the past few months, copied from English pharmaceutical journals, calling attention to the styptic properties of plantain leaves—*Plantago major*—having attracted my attention, I determined to try a few experiments when opportunity offered. Having a shiftless neighbor whose yard produced a bountiful crop of the article, I was easily able to secure an abundant supply for my experiments. Believing that better results would be obtained from fresh plants than from dried, I expressed the juice from them by means of an “Enterprise” mill, obtaining about 16 fluid ounces of juice from 3 pounds of leaves. The juice was of a light green color, very turbid, evidently caused by a large amount of chlorophyl. Setting aside 4 ounces of the filtered liquid for further experimenting, I packed the residue from the press into a conical glass percolator and exhausted with dilute alcohol, evaporating the percolate in a water-bath to two ounces, mixing with the 12 ounces of expressed juice and adding 2 ounces of alcohol. This preparation, which I call a fluid extract, represents virtually equal parts by weight of the dried plants. It is of a dark brown color with a marked odor of the recent plant, and so far, after standing three months undisturbed on my shelves, shows no sign of precipitation.

My next experiment was a mixture of equal quantities of the expressed juice with glycerin. At the present time, after standing three months, the mixture is clear and bright, with no sign of precipitation. This, I think, promises to be the most efficient preparation, and will prove valuable as an injection in the treatment of leucorrhoea, hemorrhages, and similar disorders.

Experiment number three was made with equal parts of the juice and alcohol, and number four with three parts of the juice with one part of alcohol.

In a short time a precipitate was observed in both samples in about equal proportions, and was removed about one month after making by filtering through paper, and neither has shown signs of precipitation since, and continue bright, clear, light-brown liquids.

Of their therapeutic value as styptics, I have not had sufficient trial to form an opinion, although, as far as I can judge, they have proved satisfactory. While writing this article, a cook from a neighboring restaurant, with a finger sliced off in a potato slicer, exposing



the bone, came in for treatment. Having bandaged I applied the glycerate, which soon stopped the profuse bleeding, giving her a small bottle of it to apply subsequently. I asked her to report to me in two or three days, and, on reporting, I found a healthy granulation presenting. Its styptic properties are undoubtedly due to tannic acid, as all the tests I have been able to make prove this to be the case. The readiness with which it can be obtained in the summer renders it a valuable adjunct, undoubtedly, to the materia medica of the country practitioner or housewife for stopping hemorrhages in simple wounds.



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The bruised leaves applied directly usually prove sufficient for the purpose; as to whether it will prove sufficiently valuable to add to our list of pharmaceutical preparations will require longer and more extended experiment.—*New Remedies*.

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DANGER FROM FLIES.

Dr. Grassi is said (*British Medical Journal*) to have made an important, and by no means pleasant, discovery in regard to flies. It was always recognized that these insects might carry the germs of infection on their wings or feet, but it was not known that they are capable of taking in at the mouth such objects as the ova of various worms, and of discharging them again unchanged in their faeces. This point has now been established, and several striking experiments illustrate it. Dr. Grassi exposed in his laboratory a plate containing a great number of the eggs of a human parasite, the *Tricocephalus dispar*. Some sheets of white paper were placed in the kitchen, which stands about ten meters from the laboratory. After some hours, the usual little spots produced by the faeces of flies were found on the paper. These spots, when examined by the microscope, were found to contain some of the eggs of the tricocephalus. Some of the flies themselves were then caught, and their intestines presented large numbers of the ova. Similar experiments with the ova of the *Oxyuris vermicularis* and of the *Toenia solium* afforded corresponding results. Shortly after the flies had some mouldy cream, the *Oidium lactis* was found in their faeces. Dr. Grassi mentions an innocuous and yet conclusive experiment that every one can try. Sprinkle a little lycopodium on sweetened water, and afterward examine the faeces and intestines of the flies; numerous spores will be found. As flies are by no means particular in choosing either a place to feed or a place to defecate, often selecting meat or food for the purpose, a somewhat alarming vision of possible consequences is raised.

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THE ZOOLOGICAL SOCIETY'S GARDENS.

The erection of the new house for the accommodation of the serpents, alligators, and other reptiles, which is shown in our illustration, must be commended as a valuable improvement of the Zoological Society's establishment in Regent's Park. This building, which has a rather stately aspect and is of imposing dimensions, constructed of brick and terracotta, with a roof of glass and iron, stands close to the south gate of the Gardens, entered from the Broad Walk of the Park. The visitor, on entering by that gate, should turn immediately to the left hand, along the narrow path beside the aviary of the Chinese golden pheasants, and will presently come to the Reptile House, which is too

much concealed from view by some of the sheds for the deer. The spacious interior, represented



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in our view, is one of the most agreeable places in the whole precinct of these gardens, being well aired and lighted, very nicely paved, and tastefully decorated in pale color, with some fine tropical plants in tubs on the floor, or in the windows, and in baskets hanging from the roof. Three oval basins, with substantial margins of concrete, so formed as to prevent the reptiles crawling over them, while one basin is further protected by an iron grating, contain water in which the alligators, the infant crocodiles, and a number of tortoises, but none of the larger species, make themselves quite at home. One side of the house, with its windows looking into a pleasant airy vestibule, is occupied by many small glass cases for the smaller lizards, with boxes and pots of flowers set between them upon tables, which present a very attractive exhibition. The other three sides of the hall, which is nearly square, are entirely devoted to the large wall cages, with fronts of stout plate glass, in single sheets, rising about 14 feet to the roof, in which the serpents are confined—the huge pythons, anaconda, and boa constrictor, the poisonous cobras and rattlesnakes, and others well known to the visitors at these gardens. Each cage or compartment has a sliding door of iron behind, to which the keeper has access in a passage running along the back of the wall, and there are doors also from one compartment to another. The floor is of smooth slate, and the largest snake has ample space to uncoil itself, or to climb up the trunks and branches of trees placed there for its exercise and amusement.

[Illustration: THE ZOOLOGICAL SOCIETY'S GARDENS. THE BABIROUSSA FAMILY.]

THE BABIROUSSA.

We present, on the same page, a few sketches of the babiroussas, a male and two females, with a young one, recently presented to the society by Dr. F.H. Bauer. These animals, which are from Celebes, in the Malay Archipelago, have been placed temporarily in different stalls of the ostrich house, on the north side of the gardens. The babiroussa is a species of wild hog, peculiar to the islands of Eastern Asia, and remarkable, in the male animal, for the extraordinary growth and direction of the canine teeth. The upper pair of canine teeth, growing out through the upper jaw, curve backward and upward on the forehead, having somewhat the aspect of horns; while the lower canine teeth form a pair of crooked tusks in the under jaw. These teeth may be useful for defensive fighting, as a guard to the head, but could not serve for attack. The skull of a babiroussa, with the teeth fully developed, is in the possession of Mr. Bartlett, the able superintendent of the Zoological Society's collection.—*Illustrated London News*.

[Illustration: THE ZOOLOGICAL SOCIETY'S GARDENS. THE NEW REPTILE HOUSE.]

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Continued from SUPPLEMENT, No. 363, page 5797.



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ON THE MINERALOGICAL LOCALITIES IN AND AROUND NEW YORK CITY.

PART IV.

By NELSON H. DARTON.

Montville, Morris County, New Jersey.—This locality is an old one, and well known to mineralogists. It is outside of the limits prescribed in introducing this series of paper, but by only a few miles, and being such an interesting locality, I have included it in the granular limestone, which occurs in a small isolated ridge in the gneiss within a space of ten acres, about two miles north of the railroad station of Montville, on the Boonton Branch of the Delaware, Lackawanna, and Western Railroad, and is reached by a road running north from about a mile east of the railroad station. This road branches into two at the limestone kilns, about a mile from the railroad track, and the left hand branch is taken, which leads more directly to the quarry, which is on the right hand, about a mile further on, and quite conspicuous by the loose rock lying in front of the quarry. It is on the property of a Mr. John J. Gordon, and produces a very fine limestone for use in the furnaces and forges in the vicinity, as well as lime for agricultural purposes, it being the only limestone in the vicinity for fifteen miles. Between it and its walk of gneiss occur veins of the minerals so characteristic of the locality, and for which it has become famous—serpentine, asbestos, phlozopite, gurhofite pyrites, biotite, aragonite, dolomite, tremolite, and possibly others in lesser quantity.

Serpentine.—All the varieties of this species, and of every color from nearly white to black, is profusely distributed through the limestone in the lower or main quarry in veins and pockets. It is generally soft, translucent, and to be found in masses from a pea to a cubic foot in size. Much of it is of a pure oil green color, rich and translucent, making a very fine and attractive looking mineral specimen. No difficulty need be experienced in producing all the varieties of this mineral, as much has been removed and may be found in the vicinity of the quarry, as it is always carefully separated from the limestone as being useless, and thrown aside, or in some instances, when of peculiar beauty, sold as specimens. The variety of serpentine known as marmolite, which is made up of numberless plates of the mineral packed together similar to mica, but of the green color of the serpentine picolite, or fibrous serpentine, also frequently occurs of a light grass green color, and is a very interesting variety.



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In selecting specimens of serpentine, care should be taken to procure that which is the most translucent, and that holding miniature veins of asbestos. These are not so plentiful as those of the pure serpentine alone, but occur in the southern end of the main quarry. The width of these veins of asbestos is seldom over an inch, but those of even much less are highly prized as specimens. These veins of asbestos are, in places, several inches in length, but are generally much broken in removing them, as their fibrous structure, at right angles to their length, makes them very fragile, and pure specimens of asbestos can seldom be found. However, they make much finer specimens when with the serpentine. Frequently these specimens may be obtained with a layer of guruhofite above them, and separated by the serpentine; this assortment is very interesting, revealing to us the manner in which they were formed, which was by a process termed segregation.

This guruhofite, called bone by the quarrymen, occurs in white, dense looking masses, intermingled with the serpentine, especially in the upper end of the quarry, where veins six and eight inches in thickness are abundant, and from which specimens may be readily obtained showing the fibrous structure of the guruhofite and the association with the serpentine, to which it is found attached; it is quite different from the limestone in appearance, and need not be mistaken for it.

Phlozopite.—In a vein near the lower end of the quarry, near the asbestos locality, occurs large plates of this mineral, which is a variety of mica, and has all of the characteristics of a pure silvery white color, and from one by three inches in area to less. It is easily separable in folia, and cannot be confounded with any of the other minerals. A huge mass of the veinstone holding abundance of this mineral is exposed, whence it may be plentifully obtained in excellent crystals.

Pyrites.—White and yellow iron pyrites are abundant in the gneissic rock adjoining the limestone, and frequently very fine, perfect crystals may be found handsomely dressed upon the rock. There is no particular portion of the quarries in which they abound.

Biotite.—This is a variety of mica in small crystals, of a dark brown color, and quite plentiful in the gneiss inclosing the veins of limestone. Up in the older quarries it is more abundant; on the north wall of the vein it is often in very fine specimens, and there even in large number, in a locality, generally a pocket in the gneiss.

Tremolite is quite abundant on a large mass of limestone in the extreme upper quarry, which is a short distance east of the main one, over a small hill. The tremolite occurs in white crystals, about a quarter inch in width and from a half to three inches in length. The crystals are opaque, but very smooth and glistening, lining cavities in this mass of limestone. It is a variety of hornblende, composed of silica, lime, and magnesia, with a little alumina. It probably occurs in places in the vicinity of this block, and in finer specimens, as these are frequently, when near the surface, much weathered and worn.

This is a characteristic granular limestone mineral, and a very interesting one. We will again meet it when examining the New York city localities.

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Aragonite occurs in very small masses, of a light yellow color and fibrous structure, between layers of serpentine. When they are separated by a small interspace, as it frequently is, the fibers are very large, coarse, and brittle, and thus do not resemble asbestos, although in some instances they might be mistaken for picolite, but, distinguished from it by effervescing on contact with a drop of acid, as it is a carbonate of lime, and also containing a trace of iron. I have never seen any fine specimens of it from this locality, but deeper down in the rock it may occur in greater profusion.

Dolomite occurs to a limited extent as such; most of it, being in the form of *guruhofite* crystals, may be occasionally found with *aragonite* of a light pearly gray color and rhombohedral crystals. As before noticed, Staten Island is the best locality for this species.

Calcite.—In places the limestone is perfectly crystallized, and of a pure white or other color, when it forms an attractive mineral, and often worth removing. The limestone of the main quarry, carefully averaged, was found to have the following chemical composition.

Lime. 11.09
Magnesia. 37.94
Carbonic acid. 30.61
Silica. 10.22
Water and loss. 4.90
Iron and alumina. 5.24

100.00

In places it is spotted with the serpentine, and judging from its rough state resembles "*verde antique*," and at that of a beautiful color; samples of this should be obtained.

Feldspar.—This mineral occurs very plentifully in the space between the limestones and gneiss. It is generally of a flesh red color and often in very perfect crystals, in some instances an inch and a half in length; as its hardness is 6, it can be readily distinguished from calcite, which it much resembles, but which has only a hardness of 3, and dissolves with effervescence in acids.

A visit to this locality is a delightful manner in which to spend a holiday or other time of leisure; and as it affords so many interesting and valuable minerals, it forms a very profitable trip as well. In reaching it many interesting localities are passed, and if one has an early start these may all be visited. I will describe a few of these, which are alike possessors of beautiful scenery and instructing geological features and not far from the main line of travel.



Starting from the Erie depot, on the Greenwood Lake road, the first stop may be at Arlington, about seven miles west of Jersey City. Here a visit to the Schuyler copper mine may be profitably taken; and as I have written a full account of this locality in a previous portion of these articles,[1] I will not reiterate it here, but refer to that paper. The mine, I might add, is only a mile north of the railroad station, and on Schuyler Avenue, a short distance north from its junction with the Jersey City and Paterson



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turnpike. Coming back to Arlington depot, and walking on the track for about a quarter of a mile west through the deep cut, the manner in which the sandstones and shales which constitute so large a portion of New Jersey are laid and arranged can be seen to great advantage, this being one of the finest exposures in the formation. At a point about equidistant from either end is a fault in the layers of shales and sandstone; this fault is noticeable as a slight irregularity in the otherwise continuous sides of the cut, and is a point at which the layers of rock on the east have fallen vertically, the western side remaining in its original position. This fault has a thrust of only three feet, but is an instructive example of faults which occur on a tremendous scale in some of the other formations. It will be noticed that between the two edges of the separated layers there is a deposit of a talcky substance, which has been derived from infiltrating waters. Fissure veins are generally in positions of this kind, formed and filled in a similar manner, but with the various metallic ores. Passing further west a short distance we reach the Passaic River, and walk along its banks for a mile north to the Belleville bridge; at this point is the intake of the Jersey City water works, with their huge Worthington pumps and other accessories, which may be conveniently visited. The Passaic River is then crossed, and the train on the Newark and Paterson road may be taken for three miles to Avondale, from whence it is two miles east to the Belleville sandstone quarries, or the bank of the Passaic may be followed and the quarries reached in an hour from Belleville. Here again are met the sandstones and shales, besides another and larger fault, and many interesting features of the sandstone and its quarrying may be examined. The railroad station having been regained, Paterson is the next point of interest. The first thing noticeable in approaching the city are the quarries in the side of the hills to the south, and these may be visited the first; they are but a short distance southeast of the station. Here the sandstone will be found in contact with the trap above and the layers of basalt, trap, tufa, sandstone, shales and conglomerates are exposed. Regaining the nearest railroad track (the Boonton branch of the D., L. & W.R.R.), this is followed for some distance west, when the various strata can be examined in the cut of the railroad and a fault of nearly sixty feet in the trap; this is noticed as a depression in the face of the cliff, and it may be seen by the superposition of the layers of trap and basalt. Where the fault occurs a short distance further west, there is another smaller fault. A visit to the Great Falls of the Passaic is a very pleasurable diversion at this point, and these are about a half mile north of this locality. Here the arrangement of the trap and sandstones can be again profitably studied, and the mineralogical localities which I have described in



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a former one of these articles[2] examined, not omitting the one at West Paterson, wherein so much phrenite may be found. Taking the train from West Paterson to Little Falls, a walk of a few miles south brings us to the Little Falls, and here is another interesting locality wherein the contact of the sandstone and trap may be examined and the numerous additional phenomena studied. A quarry near the Falls is the best point in which to find these exposures, and from the viaduct crossing the river an excellent view of the surrounding country may be obtained. Regaining the train, Montville is soon reached and visited, and after this, if time sufficient Boonville, two miles west, may be taken in, or it may be necessary to go there to catch a return train, as but few stop at Montville. At Boonton there are many interesting features—iron works furnaces, localities in which fossil remains are found, footprints, conglomeritic beds, and many other things, of which I will endeavor to give a detailed account in some other of this series of articles.

[Footnote 1: See SCIENTIFIC AMERICAN SUPPLEMENT, No. 363.]

[Footnote 2: See SCIENTIFIC AMERICAN SUPPLEMENT, No. 363.]

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DISCOVERY OF ANCIENT CHURCH IN JERUSALEM.

An account of the newly discovered church, north of the Damascus Gate, Jerusalem, appears in the Quarterly Statement of the Palestine Exploration Fund. The author is Dr. Selah Merrill. The ruin has proved to be one of great extent, and of special interest. The way in which it was brought to light is worth recording. In an uneven field, which rose considerably above the land about it, parts of which appearing, indeed, like little hillocks, the owner of the soil tried to maintain a vegetable garden, but the ground was so dry that neither grain nor vegetables would flourish, and even irrigation did little or no good; besides, here and there large holes appeared in the ground which could not be accounted for. At last the owner determined to dig and see what there was below the surface of his field, and to his surprise he very soon came upon fine walls and a pavement. The excavations being followed up have laid bare a church with some of the surrounding buildings. The amount of *debris* which had accumulated above the floor of these buildings was 10 to 20 feet in depth. To remove this mass of earth has required much time and labor, and the work is not yet completed. The piece of ground in question has about 60 yards of frontage on the main road, and extends, so far as the excavations go, about the same distance back from the road, that is, to the east.



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The church itself is situated on the south side of this plot, and is very near the street. The ground in front of the church is paved with fine slabs of stone. The steps by which the church was entered were 5 feet wide, but the doorway itself was somewhat wider. From the entrance to the altar step, or platform, the distance is 55 feet, and from that point to the back of the apse 15 feet 6 inches; the width of the apse is 16 feet 6 inches. The width of the church is 24 feet 6 inches. Nine feet in front of the altar step a wall has been thrown across the church in a manner similar to that in the church of the Nativity at Bethlehem. This wall, also those of the church, of which several courses remain, and the interior of the apse, show that the building was originally painted, and some of the figures and designs can still be traced. At the southeast corner of the church, leading from the apse, there is a narrow but well built passageway to the buildings in the rear. The character of these buildings is not very evident; certainly they did not stand on a line with the church, but at an angle of 25 deg. with that line. Between the church and what appears now to have been the main building in the rear, there was a passage not over 3 feet wide. The main building in the rear of the church is 47 feet 6 inches long, but to this must be added 20 feet more of a special room, which seems to have belonged to it, and which had a beautiful mosaic pavement. Thus the extreme length from the entrance of the church to the (present) east side of this mosaic floor is 140 feet.

On the west side of this mosaic floor, where it joins the wall of the main building, there is a threshold of a single stone, 9 feet 6 inches long, with a step 6 feet 9 inches in the clear. This is considerably wider, it will be seen, than the steps, and even the entrance of the church. Several patches of mosaic pavement have been found, but in one place two or three square yards have been preserved, enough to show that the work was extremely beautiful. The colored tracings resemble those in the church on the Mount of Olives, and on one side are the large Greek letters [Theta][epsilon][omicron][nu]. North of this mosaic floor, and of the main building which joins it, and running alongside of both, there is a watercourse or channel cut in the solid rock, which has been leveled to accommodate the buildings above. This can be traced in an east and west line for a distance of 37 feet; it is 2 feet 3 inches deep, 20 inches wide at the top and 12 at the bottom. From about the middle of the mosaic floor this channel turns a right angle and runs 20 feet or more to the north; it is possible that it led *from* the north, and at the point indicated turned a right angle and ran to the west. Piles of stones and *debris* prevent us at present from deciding as to the length of the channel or where it comes from. In the bank of *debris*, which rises on the east side of the



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mosaic floor to a height of 20 feet, there is, about 6 feet above the floor, a watercourse formed of cement, running north and south at right angles to the line of the church and the other buildings, which must have belonged to a much later period. In fact—and this is an interesting circumstance—the mosaic pavement appears to extend under and beyond this canal and the mass of *debris* which is yet to be removed.

In the northwest corner of the room, where the mosaic floor is found, very near the angle (already mentioned) of the rock-cut channel, there is a tomb about 6 feet below the surface or level of the floor. The tomb is 10 feet long and 9 feet wide, and is entered by a doorway 26 inches wide, which is well built, and in the sides of which are grooves for a door to slide up and down. On the wall of the tomb at the east end there is a raised Greek cross, 22 inches long and 13 inches wide. One cannot stand erect in its highest part, but it is to be considered that the loculi are two-thirds full of *debris*, composed chiefly of decayed bones and bits of glass. Those in charge of the excavations have not, up to the present time, allowed the tombs to be cleared out. The loculi are 2 feet in depth.

What Captain Conder speaks of as “vaults north of the church,” turn out to be the tops of houses. They are four in number, each 75 feet long by 28 feet wide, and faced the street. They were divided (one or two of them at least) into apartments by means of arches. The lower courses of the walls, to the height of several feet, are of squared stones, while the upper portions and the roofs are of rubble work, which was covered with a heavy coating of plaster. The threshold of one has been exposed, which is 6 feet in the clear, and the sides of the doorway show excellent work.

Among the ruins there are two sections of marble columns, each 33 inches in diameter. Three large cisterns have been found, two of which were nearly full of water; the mouths of these, which were closed, were many feet below the surface of the ground before the excavations began, hence no one knows how old the water in them may be. Some of the slabs with which the church was paved were 6 feet long by 21/2 feet wide. In the church two pieces of cornice were found, each 8 feet in length. One is entire and quite plain, while the other is broken in the middle. It is upon this that the figures of Christ and his twelve apostles were painted. They can still be traced, although exposure has nearly obliterated the colors. Pottery and a considerable quantity of broken glass have been found and some small articles in marble of no great value. The top of a certain block of marble has been formed into a basin, and a hole drilled the entire length of the block for the water to run off.

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South of the mosaic floor and of the east end of the main building there is a large underground chamber with seven openings (each the size of a man's body) to the surface. The chamber is 12 feet wide and nearly 20 feet long, but the depth is not yet ascertained, owing to the accumulation of *debris* on the bottom. On the west and north sides a wall of solid rock appears to a depth of 6 feet, showing that the chamber was excavated in part at least in the solid rock. The use of this chamber does not appear evident, unless it may have been a store room. The place within the city shown as "Peter's Prison" consists of a similar chamber (not dug in the solid rock, however), with similar openings in the ceiling or roof. The ruins extend underground some distance to the east of the mosaic floor, and efforts are being made to purchase the land in that direction, in order to allow of the excavations being extended there. It is almost equally certain that the buildings extended to the south and southeast of the present plat of ground. But the owners of the land are jealous, and everybody is superstitious; consequently, excavations must be abandoned, or move with aggravating slowness.

Dr. Selah Merrill, in a note describing a late visit, says that the west wall of what he called the "main building," toward the apse of the church, has been removed and the floor cleared, exposing a fine pavement. This pavement, the threshold before mentioned, and the mosaic floor all belong to one period, and to a structure very much older than the date of the "main building." It puzzled the doctor, because the threshold west of the mosaic floor was not square with the east wall of the "main buildings," but the reason is now clear. Captain Conder says of this church with such of the ruins about it as were exposed when he was there, that "the whole is evidently of the Crusading period." As regards the church itself, this is not clear, and the mosaic floor especially may belong to a time many centuries previous to that era. At the south side of the floor of the "main building" a new mouth to the largest cistern has been discovered; over the mouth there is a thick stone 5 feet in diameter. This was eight sided, and was built against the wall, so that five sides are exposed. The stone was cut in such a way as to leave on two of its sides small brackets shaped like the two halves of the utensil called a "tunnel." It may be of interest to state that this piece of land was offered for sale a few years since, and for a long time went a begging for a purchaser; at last it was sold for 40 Napoleons. During the present year it has passed into the hands of the French for 2,000 Napoleons.

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DAMMARA AUSTRALIS



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One of the noblest evergreen trees in that noblest of collections of such plants contained in the Temperate House at Kew, is the subject of the present note. Some months since cones were observed to be forming on this tree, and a representation of which we are now enabled, through the courtesy of Mrs. Dyer, to lay before our readers. We are not aware whether the tree has previously produced cones at Kew, though we have the impression that such is the case; at any rate it has done so elsewhere, as recorded in the *Flore des Serres*, 1856, p. 75, but fertile seed was not yielded, owing to the absence of pollen.

In this country the tree is only valuable for its massive aspect and richly colored thick evergreen leaves, borne on successive tiers of branches, which render it specially suitable for the decoration of winter gardens, corridors, and such like situations, where no great amount of heat is required. In the northern island of New Zealand, however, it is quite another matter, for there, where it is known as the Kauri Pine, it furnishes the most valuable of timbers, as may be judged from the fact that the trunk of the tree attains a height of from 50 to 100 feet clear of the branches; moreover, it yields a gum resin like copal, which exudes from the trunk, and which is sometimes found below ground in the vicinity of the trees, thus giving the clew to the real nature of amber and other similar substances.

[Illustration: THE KAURI PINE.—DAMMARA AUSTRALIS.]

The timber is of slow growth, especially valuable for the construction of masts of ships, its durability, strength, and elasticity rendering it particularly suitable for this purpose, and Laslett speaks of it as one of the best woods for working that the carpenter can take in hand, and recommends its use for the decks of yachts, for cabin panels, for joiner's work generally, or for ornamental purposes. Owing to the difficulty and expense of working the forests, and the great distance, comparatively little of it comes to this country.—*The London Gardeners' Chronicle*.

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HOW TO SUCCESSFULLY TRANSPLANT TREES.

Many think it cheaper and better to take up large trees from the woods, and transplant them to their grounds or to the road-side, than to buy nursery trees. As a rule, such trees die; they fail because proper precautions have not been taken. In digging up a tree, all the roots outside of a circle a few feet in diameter are cut off, and the tree is reset with its full head of branches. Whoever has seen trees in the forest that were upturned by a tornado, must have been struck by the manner in which the roots run very near to the surface, and to a great distance. When the roots of these trees are cut off at two or three feet from the trunk, few or no fibrous or feeding roots are left; and if the mass of tops is left, the expansion of the buds in the spring will not be responded to



by a supply of sap from the roots, and death must follow. If such trees have the tops completely removed, leaving only a bare pole, they will usually grow when transplanted. The tree is little more than an immense cutting; but there are roots enough left to meet the demand of the few shoots that start from the top, and growth above and below ground is well balanced.



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We have seen maples, elms, and basswood trees, fifteen feet or more high, transplanted in this manner, without failure. Some trees treated in this manner were planted in our neighborhood about ten years ago. They have now as fine heads as one would wish, and show no signs of former rough treatment. Trees in pastures, or on the edge of the woods, are better furnished with roots. These should be prepared for transplanting by digging down to the roots, and cutting off all that extended beyond the desired distance. This will cause the formation of fibrous roots near the tree. It will be safer to take two years for the operation, cutting half of the roots each year. Such trees may be removed in safety, especially if a good share of the top is removed at transplanting—*American Agriculturist*.

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