Scientific American Supplement, No. 829, November 21, 1891 eBook

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Contents

Scientific American Supplement, No. 829, November 21, 1891 eBook....1

Contents....2

Table of Contents....5

Page 1....7

Page 2....8

Page 3....9

Page 4....10

Page 5....12

Page 6....13

Page 7....14

Page 8....16

Page 9....17

Page 10....19

Page 11....21

Page 12....23

Page 13....25

Page 14....26

Page 15....27

Page 16....29

Page 17....31

Page 18....32

Page 19....34

Page 20....35

Page 21....36

Page 22....37

Page 23.....38
Page 24.....39
Page 25.....40
Page 26.....41
Page 27.....42
Page 28.....43
Page 29.....45
Page 30.....46
Page 31.....47
Page 32.....48
Page 33.....49
Page 34.....50
Page 35.....51
Page 36.....52
Page 37.....53
Page 38.....54
Page 39.....56
Page 40.....58
Page 41.....60
Page 42.....62
Page 43.....64
Page 44.....65
Page 45.....67
Page 46.....69
Page 47.....71
Page 48.....73

Page 49.....75
Page 50.....77
Page 51.....79
Page 52.....81
Page 53.....83
Page 54.....85
Page 55.....86
Page 56.....88
Page 57.....90
Page 58.....92
Page 59.....94
Page 60.....96
Page 61.....98
Page 62.....99
Page 63.....100
Page 64.....102
Page 65.....104
Page 66.....107
Page 67.....110
Page 68.....113
Page 69.....115
Page 70.....117
Page 71.....119
Page 72.....121
Page 73.....123

Table of Contents

Table of Contents

Section	Page
Start of eBook	1
THE SUN’S MOTION IN SPACE.	1
ANIMAL ORIGIN OF PETROLEUM AND PARAFFIN.	6
THE ORIGIN OF PETROLEUM.[1]	7
THE COLORADO DESERT LAKE.	11
HEMLOCK AND PARSLEY.	13
THE EREMURI.	15
RAPHIDES, THE CAUSE OF THE ACRIDITY OF CERTAIN PLANTS.	16
THE WHALE-HEADED STORK.	18
THE CALIFORNIA RAISIN INDUSTRY.	21
COLD AND MORTALITY.	28
ANIMAL POWER AT DIFFERENT PERIODS OF LIFE.	30
FALL OF TEMPERATURE—MODE OF ACTION.	32
EXTRACTION OF HEAT.	32
SUPPRESSED OXIDATION.	33
MECHANICAL COLD.	35
COMBINED EFFECTS.	35
SOME SIMPLE RULES.	37
THE TREATMENT OF GLAUCOMA.	38
A TWIN SCREW LAUNCH RUN BY A COMPOUND ENGINE.	38
IMPROVEMENTS IN THE CONSTRUCTION OF RIVER AND CANAL BARGES.	39
WELDON’S RANGE FINDER.	42
WHEELS LINKED WITH A BELL CRANK.	44
THE DECORATIVE TREATMENT OF NATURAL FOLIAGE.[1]	45
THE CYCLOSTAT.	53
MERCURY WEIGHING MACHINE.	55
REEFING SAILS FROM THE DECK.	56
A NEW PROCESS FOR THE BLEACHING OF JUTE.	57
	58

PRIMARY BATTERIES. 58
SECONDARY BATTERIES. 59
ON THE ELIMINATION OF SULPHUR FROM PIG IRON.[1] 60
ON THE OCCURRENCE OF TIN IN CANNED FOOD. 63
METHOD. 64
RESULTS OF EXAMINATION. 64
NEW PROCESS FOR THE MANUFACTURE OF CHROMATES. 68
A VIOLET COLORING MATTER FROM MORPHINE. 70
LIQUID BLUE FOR DYEING. 70
A NEW CATALOGUE OF VALUABLE PAPERS 71
THE SCIENTIFIC AMERICAN 71
BUILDING PLANS AND SPECIFICATIONS. 71
THE 72
USEFUL ENGINEERING BOOKS 72
PATENTS! 72

Page 1

THE SUN'S MOTION IN SPACE.

By A.M. CLERKE.

Science needed two thousand years to disentangle the earth's orbital movement from the revolutions of the other planets, and the incomparably more arduous problem of distinguishing the solar share in the confused multitude of stellar displacements first presented itself as possibly tractable a little more than a century ago. In the lack for it as yet of a definite solution there is, then, no ground for surprise, but much for satisfaction in the large measure of success attending the strenuous attacks of which it has so often been made the object.

Approximately correct knowledge as to the direction and velocity of the sun's translation is indispensable to a profitable study of sidereal construction; but apart from some acquaintance with the nature of sidereal construction, it is difficult, if not impossible, of attainment. One, in fact, presupposes the other. To separate a common element of motion from the heterogeneous shiftings upon the sphere of three or four thousand stars is a task practicable only under certain conditions. To begin with, the proper motions investigated must be established with *general* exactitude. The errors inevitably affecting them must be such as pretty nearly, in the total upshot, to neutralize one another. For should they run mainly in one direction, the result will be falsified in a degree enormously disproportionate to their magnitude. The adoption, for instance, of system of declinations as much as 1" of arc astray might displace to the extent of 10 deg. north or south the point fixed upon as the apex of the sun's way (see L. Boss *Astr. Jour.*, No. 213). Risks on this score, however, will become less formidable with the further advance of practical astronomy along a track definable as an asymptote of ideal perfection.

Besides this obstacle to be overcome, there is another which it will soon be possible to evade. Hitherto, inquiries into the solar movement have been hampered by the necessity for preliminary assumptions of some kind as to the relative distances of classes of stars. But all such assumptions, especially when applied to selected lists, are highly insecure; and any fabric reared upon them must be considered to stand upon treacherous ground. The spectrographic method, however, here fortunately comes into play. "Proper motions" are only angular velocities. They tell nothing as to the value of the perspective element they may be supposed to include, or as to the real rate of going of the bodies they are attributed to, until the size of the sphere upon which they are measured has been otherwise ascertained. But the displacement of lines in stellar spectra give directly the actual velocities relative to the earth of the observed stars. The question of their distances is, therefore, at once eliminated. Now the radial component of stellar motion is mixed up, precisely in the same

Page 2

way as the tangential component, with the solar movement; and since complete knowledge of it, in a sufficient number of cases, is rapidly becoming accessible, while knowledge of tangential velocity must for a long time remain partial or uncertain, the advantage of replacing the discussion of proper motions by that of motions in line of sight is obvious and immediate. And the admirable work carried on at Potsdam during the last three years will soon afford the means of doing so in the first, if only a preliminary investigation of the solar translation based upon measurements of photographed stellar spectra.

The difficulties, then, caused either by inaccuracies in star catalogues or by ignorance of star distances may be overcome; but there is a third, impossible at present to be surmounted, and not without misgiving to be passed by. All inquiries upon the subject of the advance of our system through space start with an hypothesis most unlikely to be true. The method uniformly adopted in them—and no other is available—is to treat the *inherent* motions of the stars (their so-called *motus peculiares*) as pursued indifferently in all directions. The steady drift extricable from them by rules founded upon the science of probabilities is presumed to be solar motion visually transferred to them in proportions varying with their remoteness in space, and their situations on the sphere. If this presumption be in any degree baseless, the result of the inquiry is *pro tanto* falsified. Unless the deviations from the parallactic line of the stellar motions balance one another on the whole, their discussion may easily be as fruitless as that of observations tainted with systematic errors. It is scarcely, however, doubtful that law, and not chance, governs the sidereal revolutions. The point open to question is whether the workings of law may not be so exceedingly intricate as to produce a grand sum total of results which, from the geometrical side, may justifiably be regarded as casual.

The search for evidence of a general plan in the wanderings of the stars over the face of the sky has so far proved fruitless. Local concert can be traced, but no widely diffused preference for one direction over any other makes itself definitely felt. Some regard, nevertheless, *must* be paid by them to the plane of the Milky Way; since it is altogether incredible that the actual construction of the heavens is without dependence upon the method of their revolutions.

The apparent anomaly vanishes upon the consideration of the profundities of space and time in which the fundamental design of the sidereal universe lies buried. Its composition out of an indefinite number of partial systems is more than probable; but the inconceivable leisureliness with which their mutual relations develop renders the harmony of those relations inappreciable by short-lived terrestrial denizens. “Proper motions,” if this be so, are of a subordinate

Page 3

kind; they are indexes simply to the mechanism of particular aggregations, and have no definable connection with the mechanism of the whole. No considerable error may then be involved in treating them, for purposes of calculation, as indifferently directed, and the elicited solar movement may genuinely represent the displacement of our system relative to its more immediate stellar environment. This is perhaps the utmost to be hoped for until sidereal astronomy has reached another stadium of progress.

Unless, indeed, effect should be given to Clerk Maxwell's suggestion for deriving the absolute longitude of the solar apex from observations of the eclipses of Jupiter's satellites (Proc. Roy. Soc., vol. xxx., p. 109). But this is far from likely. In the first place, the revolutions of the Jovian system cannot be predicted with anything like the required accuracy. In the second place, there is no certainty that the postulated phenomena have any real existence. If, however, it be safe to assume that the solar system, cutting its way through space, virtually raises an ethereal counter-current, and if it be further granted that light travels less *with* than *against* such a current, then indeed it becomes speculatively possible, through slight alternate accelerations and retardations of eclipses taking place respectively ahead of and in the wake of the sun, to determine his absolute path in space as projected upon the ecliptic. That is to say, the longitude of the apex could be deduced together with the resolved part of the solar velocity; the latitude of the apex, as well as the component of velocity perpendicular to the plane of the ecliptic, remaining, however, unknown.

The beaten track, meanwhile, has conducted two recent inquirers to results of some interest. The chief aim of each was the detection of systematic peculiarities in the motions of stellar assemblages after the subtraction from them of their common perspective element. By varying the materials and method of analysis, Prof. Lewis Boss, Director of the Albany Observatory, hopes that corresponding variations in the upshot may betray a significant character. Thus, if stars selected on different principles give notably and consistently different results, the cause of the difference may with some show of reason be supposed to reside in specialties of movement appertaining to the several groups. Prof. Boss broke ground in this direction by investigating 284 proper motions, few of which had been similarly employed before (*Astr. Jour.*, No. 213). They were all taken from an equatorial zone 4 deg. 20' in breadth, with a mean declination of +3 deg., observed at Albany for the catalogue of the Astronomische Gesellschaft, and furnished data accordingly for a virtually independent research of a somewhat distinctive kind. It was carried out to three separate conclusions. Setting aside five stars with secular movements ranging above 100", Prof. Boss divided the 279 left available

Page 4

into two sets—one of 185 stars brighter, the other of 144 stars fainter than the eighth magnitude. The first collection gave for the goal of solar translation a point about 4 deg. north of [alpha] Lyrae, in R.A. 280 deg., Decl. +43 deg.; the second, one some thirty-seven minutes of time to the west of [delta] Cygni, in R.A. 286 deg., Decl. +45 deg.. For a third and final solution, twenty-six stars moving 40"-100" were rejected, and the remaining 253 classed in a single series. The upshot of their discussion was to shift the apex of movement to R.A. 289 deg., Decl. +51 deg.. So far as the difference from the previous pair of results is capable of interpretation, it would seem to imply a predominant set toward the northeast of the twenty-six swifter motions subsequently dismissed as prejudicial, but in truth the data employed were not accurate enough to warrant so definite an inference. The Albany proper motions, as Prof. Boss was careful to explain, depend for the most part upon the right ascensions of Bessel's and Lalande's zones, and are hence subject to large errors. Their study must be regarded as suggestive rather than decisive.

A better quality and a larger quantity of material was disposed of by the latest and perhaps the most laborious investigator of this intricate problem. M. Oscar Stumpe, of Bonn (*Astr. Nach.*, Nos. 2,999, 3,000), took his stars, to the number of 1,054, from various quarters, if chiefly from Auwers' and Argelander's lists, critically testing, however, the movement attributed to each of not less than 16" a century. This he fixed as the limit of secure determination, unless for stars observed with exceptional constancy and care. His discussion of them is instructive in more ways than one. Adopting, the additional computative burden imposed by it notwithstanding, Schonfeld's modification of Airy's formulae, he introduced into his equations a fifth unknown quantity expressive of a possible stellar drift in galactic longitude. A negative result was obtained. No symptom came to light of "rotation" in the plane of the Milky Way.

M. Stumpe's intrepid industry was further shown in disregard of customary "scamping" subterfuges. Expedients for abbreviation vainly spread their allurements; every one of his 2,108 equations was separately and resolutely solved. A more important innovation was his substitution of proper motion for magnitude as a criterion of remoteness. Dividing his stars on this principle into four groups, he obtained an apex for the sun's translation corresponding to each as follows:

Group	Number of included stars.	Proper motion. " "	Apex. deg. deg.
I.	551	0.16 to 0.32	R.A. 287.4 Decl. +42.
II.	340	0.32 to 0.64	" 279.7 " 40.5
III.	105	0.64 to 1.28	" 287.9 " 32.1
IV.	58	1.28 and upward	" 285.2 " 30.4

Here again we find a marked and progressive descent of the apex toward the equator with the increasing swiftness of the objects serving for its determination, leading to the suspicion that the most northerly may be the most genuine position, because the one least affected by stellar individualities of movement.

Page 5

By nearly all recent investigations, moreover, the solar *point de mire* has been placed considerably further to the east and nearer to the Milky Way than seemed admissible to their predecessors; so that the constellation Lyra may now be said to have a stronger claim than Hercules to include it; and the necessity has almost disappeared for attributing to the solar orbit a high inclination to the medial galactic plane.

From both the Albany and the Bonn discussions there emerged with singular clearness a highly significant relation. The mean magnitudes of the two groups into which Prof. Boss divided his 279 stars were respectively 6.6 and 8.6, the corresponding mean proper motions 21".9 and 20".9. In other words, a set of stars on the whole six times brighter than another set owned a scarcely larger sum total of apparent displacement. And that this approximate equality of movement really denoted approximate equality of mean distance was made manifest by the further circumstance that the secular journey of the sun proved to subtend nearly the same angle whichever of the groups was made the standpoint for its survey. Indeed, the fainter collection actually gave the larger angle (13".73 as against 12".39), and so far an indication that the stars composing it were, on an average, nearer to the earth than the much brighter ones considered apart.

A result similar in character was reached by M. Stumpe. Between the mobility of his star groups, and the values derived from them for the angular movement of the sun, the conformity proved so close as materially to strengthen the inference that apparent movement measures real distance. The mean brilliancy of his classified stars seemed, on the contrary, quite independent of their mobility. Indeed, its changes tended in an opposite direction. The mean magnitude of the slowest group was 6.0, of the swiftest 6.5, of the intermediate pair 6.7 and 6.1. And these are not isolated facts. Comparisons of the same kind, and leading to identical conclusions, were made by Prof. Eastman at Washington in 1889 (Phil. Society Bulletin, vol. xii, p. 143; Proceedings Amer. Association, 1889, p. 71).

What meaning can we attribute to them? Uncritically considered, they seem to assert two things, one reasonable, the other palpably absurd. The first—that the average angular velocity of the stars varies inversely with their distance from ourselves—few will be disposed to doubt; the second—that their average apparent luster has nothing to do with greater or less remoteness—few will be disposed to admit. But, in order to interpret truly, well ascertained if unexpected relationships, we must remember that the sensibly moving stars used to determine the solar translation are chosen from a multitude sensibly fixed; and that the proportion of stationary to traveling stars rises rapidly with descent down the scale of magnitude. Hence a mean struck in disregard of the zeros is totally misleading; while the account is no sooner made exhaustive than its anomalous character becomes largely modified. Yet it does not wholly disappear. There is some warrant for it in nature. And its warrant may perhaps consist in a preponderance, among suns endowed with high *physical* speed, of small or slightly luminous over powerfully radiative bodies. Why this should be so, it would be futile, even by conjecture, to attempt to explain.—*Nature.*

Page 6

* * * * *

ANIMAL ORIGIN OF PETROLEUM AND PARAFFIN.

R. Zaloziecki, in *Dingl. Polyt. Jour.*, gives a lengthy physical and chemical argument in favor of the modern view that petroleum and paraffin owe their origin to animal sources; that they are formed from animal remains in a manner strictly analogous to that of the formation of ordinary coal from wood and other vegetable debris. For geological as well as chemical reasons, the author holds that Mendeleeff's theory of their igneous origin is untenable, pointing out that the hydrocarbons could not have been formed by the action of water percolating through clefts in the gradually solidifying crust until it reached the molten metallic carbides, as these clefts could only occur where complete solidification had taken place, and between this point and the metallic stratum a considerable space would be taken up by semi-solid, slag-like material which would be quite impervious to water. Under the conditions, too, existing beneath the surface of the earth, such polymerization as is necessary to account for the presence of the different classes of hydrocarbons found in petroleum is scarcely credible.

On the other hand it is to be specially noticed that, with a few unimportant exceptions, all bituminous deposits are found in the sedimentary rocks, and that just as these are constantly changing in composition, so the organic matter present changes, there being a definite relationship between the chemical constitution of the petroleum and the age of the strata in which it is found. It is almost certain that in the most recent alluvial formations no oil is ever found, its latest appearance being in the rocks of the tertiary period, the place where the solid paraffin is almost exclusively met with; thus helping to show that the latter has been formed from the decomposition of the oil, and is not a residue remaining after the oil has been distilled off. To this conclusion the fact also strongly points, that the paraffin is much simpler in constitution, purer, and often of far lighter color than the crude oil, which could not be the case if it were the original substance.

On examining by the aid of a map the position of the chief oil-bearing localities it will be noticed that the most prolific spots follow fairly accurately the contour lines of the country, so that at one time they formed in all probability a coast line whereon would be concentrated for climatic reasons most of the animal life both of the land and sea. During succeeding generations their dead bodies would accumulate in enormous quantities and be buried in the slowly depositing sand and mud, till, owing to the gradual alterations of level, the sea no longer reached the same point. This theory is borne out by the fact that oil deposits are usually found in marine sediments, sea fossils being frequently met with. The first

Page 7

process of the decomposition of the animal remains would consist in the formation of ammonia and nitrogenous bases, the action being aided by the presence of air, moisture, and micro-organisms, at the same time, owing to the well known antiseptic properties of salt, the decomposition would go on slowly, allowing time for more sand and inorganic matter to be deposited. In this way the decomposing matter would be gradually protected from the action of the air, and finally the various fatty substances would be found mixed with large amounts of salt, under considerable pressure, and at a somewhat high temperature. From this adipocere, fatty acids would be gradually formed, the glycerol being washed away, and finally the acids would be decomposed by the pressure into hydrocarbons and free carbonic acid gas. That many of these hydrocarbons would be solid at ordinary temperatures, forming the so-called mineral wax, which exists in many places in large quantities, is much easier to imagine, in the light of modern chemical knowledge, than that the fatty acids were at once split up into the simpler liquid hydrocarbons, to be afterward condensed into the more complex molecular forms of the solid substance.

In this way from animal matter are in all probability formed the vast petroleum deposits, the three substances, adipocere, ozokerite, and petroleum oil being produced in chronological order, just as lignite, brown coal and coal are formed by the gradual decomposition of vegetable remains.

* * * * *

THE ORIGIN OF PETROLEUM.[1]

[Footnote 1: Abstract of a paper read before the British Association, Cardiff meeting, 1891, Section G.]

By O.C.D. Ross, M.Inst.C.E.

Petroleum is one of the most widely distributed substances in nature, but the question how it was originally produced has never yet been satisfactorily determined, and continues a problem for philosophers. In 1889 the total production exceeded 2,600,000,000 gallons, or about 10,000,000 tons, and, at fourpence per gallon, was worth about L44,000,000, while the recognition of its superior utility as an economical source of light, heat, and power steadily increases; but, notwithstanding its importance in industry, the increasing abundance of the foreign supply, and the ever-widening area of production, practical men in England continue to distrust its permanence, and owing to the mystery surrounding its origin, and the paucity of indications where and how to undertake the boring of wells, they hesitate to seek for it in this country, or even to extend the use of it whenever that would involve alterations of existing machinery. The

object of this paper is to suggest an explanation of the mystery which seems calculated to dissipate that distrust, since it points to very abundant stores, both native and foreign, yet undiscovered, and even in some localities to daily renovated provisions of this remarkable oil.

Page 8

The theories of its origin suggested by Reichenbach, Berthelot, Mendeleeff, Peckham, and others, made no attempt to account for the exceeding variety in its chemical composition, in its specific gravity, its boiling points, *etc*., and are all founded on some hypothetical process which differs from any with which we are acquainted; but modern geologists are agreed that, as a rule, the records of the earth's history should be read in accordance with those laws of nature which continue in force at the present day, *e.g*., the decomposition of fish and cetaceous animals could not now produce oil containing paraffin. Hence we can hardly believe it was possible thousands or millions of years ago, if it can be proved that any of the processes of nature with which we are familiar is calculated to produce it.

The chief characteristics of petroleum strata are enumerated as:

I. The existence of adjoining beds of limestone, gypsum, *etc*.

II. The evidence of volcanic action in close proximity to them.

III. The presence of salt water in the wells.

I. All writers have noticed the presence of limestone close to petroleum fields in the United States and Canada, in the Caucasus, in Burma, *etc*., but they have been most impressed by its being "fossiliferous," or shell limestone, and have drawn the erroneous inference that the animal matter once contained in those shells originated petroleum; but no fish oil ever contained paraffin. On the other hand, the fossil shells are carbonate of lime, and, as such, capable of producing petroleum under conditions such as many limestone beds have been subjected to in all ages of the earth's history. All limestone rocks were formed under water, and are mainly composed of calcareous shells, corals, encrinites, and foraminfera—the latter similar to the foraminfera of "Atlantic ooze" and of English chalk beds. Everywhere, under the microscope, the original connection of limestone with organic matter—its organic parentage, so to speak, and cousinship with the animal and vegetable kingdoms—is conspicuous. When pure it contains 12 per cent. of carbon.

Now petroleum consists largely of carbon, its average composition being 85 per cent. of carbon and 15 per cent. of hydrogen, and in the limestone rocks of the United Kingdom alone there is a far larger accumulation of carbon than in all the coal measures the world contains. A range of limestone rock 100 miles in length by 10 miles in width, and 1,000 yards in depth, would contain 743,000 million tons of carbon, or sufficient to provide carbon for 875,000 million tons of petroleum. Deposits of oil-bearing shale have also limestone close at hand; *e.g*., coral rag underlies Kimmeridge clay, as it also underlies the famous black shale in Kentucky, which is extraordinarily rich in oil.

Page 9

II. As evidence of volcanic action in close proximity to petroleum strata, the mud volcanoes at Baku and in Burma are described, and a sulphur mine in Spain is mentioned (with which the writer is well acquainted), situated near an extinct volcano, where a perpetual gas flame in a neighboring chapel and other symptoms indicate that petroleum is not far off. While engaged in studying the geological conditions of this mine, the author observed that Dr. Christoff Bischoff records in his writings that he had produced sulphur in his own laboratory by passing hot volcanic gases through chalk, which, when expressed in a chemical formula, leads at once to the postulate that, in addition to sulphur, *ethylene*, and all its homologues (C_{n}H_{2n}), which are the oils predominating at Baku, would be produced by treating:

2, 3, 4, 5 equivs. of carbonate of lime (limestone) with
2, 3, 4, 5 " sulphurous acid (SO_{2}) and
4, 6, 8, 10 " sulphureted hydrogen (H_{2}S);

and that marsh gas and its homologues, which are the oils predominating in Pennsylvania, would be produced by treating:

1, 2, 3, 4, 5 equivs. of carbonate of lime with
1, 2, 3, 4, 5 " sulphurous acid and
3, 5, 7, 9, 11 " sulphureted hydrogen.

Thus we find that:

Carbonate of lime, 2CaCO_{3}, } { 2(CaSO.H_{2}O) (gypsum),
Sulphurous acid, 2SO_{2}, and } yield { 4S (sulphur), and
Sulphureted hydrogen, 4H_{2}S, } { C_{2}H_{4}, which is

{ *ethylene*.

And that:

Carbonate of lime, CaCO_{3} } { (CaSO_{4}.H_{2}O) (gypsum),
Sulphurous acid, SO_{2}, and } yield { 3S (sulphur) and
Sulphureted hydrogen, 3H_{2}S, } { CH4, which is marsh gas.

So that these and all their homologues, in fact petroleum in all its varieties, would be produced in nature by the action of volcanic gases on limestone.

But much the most abundant of the volcanic gases appear at the surface as steam, and petroleum seems to have been more usually produced without sulphurous acid, and with part of the sulphureted hydrogen (H_{2}S) replaced by H_{2}O (steam) or H_{2}O_{2} (peroxide of hydrogen), which is the product that results from the combination of sulphureted hydrogen and sulphurous acid:

(H_{2}S + SO_{2} == H_{2}O_{2} + 2S).

It is a powerful oxidizing agent, and it converts sulphurous into sulphuric acid. Thus:

CaCO_{3} } { CaSO_{4}.H_{2}O (gypsum)
H_{2}S, } yield { and
2H_{2}O, } { CH_{4}, which is marsh gas.

And

2CaCO_{3}, } { 2CaSO_{4}.H_{2}O
2H_{2}S, } yield { and
2H_{2}O_{2}, } { C_{2}H_{4}, which is *ethylene*.

Tables are given showing the formulae for the homologues of ethylene and marsh gas resulting from the increase in regular gradation of the same constituents.

Page 10

Formulae Showing how Ethylene and its Homologues
(C{n}H_{2}{n}) are Produced by the Action of the Volcanic
Gases H_{2}S and H_{2}O_{2} on Limestone._

Carbonate Sulphureted Peroxide of Ethylene and of lime. hydrogen. hydrogen.
Gypsum. its homologues.

2CaCO3 + 2H2S + 2H2O2 yield 2(CaSO4.H2O) + C2H4 ethylene
(gaseous).
3CaCO3 + 3H2S + 3H2O2 " 3(CaSO4.H2O) + C3H6
4CaCO3 + 4H2S + 4H2O2 " 4(CaSO4.H2O) + C4H8
5CaCO3 + 5H2S + 5H2O2 " 5(CaSO4.H2O) + C5H10
6CaCO3 + 6H2S + 6H2O2 " 6(CaSO4.H2O) + C6H12
Boiling
point.
7CaCO3 + 7H2S + 7H2O2 " 7(CaSO4.H2O) + C7H14 —
8CaCO3 + 8H2S + 8H2O2 " 8(CaSO4.H2O) + C8H16 189 deg.C.
9CaCO3 + 9H2S + 9H2O2 " 9(CaSO4.H2O) + C9H18 136 deg.C.
10CaCO3 + 10H2S + 10H2O2 " 10(CaSO4.H2O) + C10H20 160 deg.C. 11CaCO3 + 11H2S + 11H2O2 " 11(CaSO4.H2O) + C11H22 180 deg.C. 12CaCO3 + 12H2S + 12H2O2 " 12(CaSO4.H2O) + C12H24 196 deg.C. 13CaCO3 + 13H2S + 13H2O2 " 13(CaSO4.H2O) + C13H26 240 deg.C. 14CaCO3 + 14H2S + 14H2O2 " 14(CaSO4.H2O) + C14H28 247 deg.C. 15CaCO3 + 15H2S + 15H2O2 " 15(CaSO4.H2O) + C15H30 —

It is explained that these effects must have occurred, not at periods of acute volcanic eruptions, but in conditions which maybe, and have been, observed at the present time, wherever there are active solfataras or mud volcanoes at work. Descriptions of the action of solfataras by the late Sir Richard Burton and by a British consul in Iceland are quoted, and also a paragraph from Lyall's "Principles of Geology," in which he remarks of the mud volcanoes at Girgenti (Sicily) that *carbureted hydrogen* is discharged from them, sometimes with great violence, and that they are known to have been casting out water, mixed with mud and *bitumen*, with the same activity as now for the last fifteen centuries. Probably at all these solfataras, if the gases traverse limestone, fresh deposits of oil-bearing strata are accumulating, and the same volcanic action has been occurring during many successive geological periods and millions of years; so that it is difficult to conceive limits to the magnitude of the stores of petroleum which may be awaiting discovery in the subterranean depths.[2]

[Footnote 2: Professor J. Le Conte, when presiding recently at the International Geological Congress at Washington, mentioned that in the United States extensive lava floods have been observed, covering areas from 10,000 to 100,000 square miles in extent and from 2,000 to 4,000 feet deep. We have similar lava flows and ashes in the North of England, in Scotland, and in Ireland, varying from 3,000 to 6,000 feet in depth.

In the Lake District they are nearly 12,000 feet deep. Solfataras are active during the intermediate, or so-called “dormant,” periods which occur between

Page 11

acute volcanic eruptions.]

Gypsum may also be an indication of oil-bearing strata, for the substitution in limestone of sulphuric for carbonic acid can only be accounted for by the action of these hot sulphurous gases. Gypsum is found extensively in the petroleum districts of the United States, and it underlies the rock salt beds at Middlesboro, where, on being pierced, it has given passage to oil gas, which issues abundantly, mixed with brine, from a great depth.

III. Besides the space occupied by “natural gas,” which is very extensive, 17,000 million gallons of petroleum have been raised in America since 1860, and that quantity must have occupied more than 100,000,000 cubic yards, a space equal to a subterranean cavern 100 yards wide by 20 feet deep, and 82 miles in length, and it is suggested that beds of “porous sandstone” could hardly have contained so much; while vast receptacles may exist, carved by volcanic water out of former beds of rock salt adjoining the limestone, which would account for the brine that usually accompanies petroleum. It is further suggested that when no such vacant spaces were available, the hydrocarbon vapors would be absorbed into, and condensed in, contiguous clays and shales, and perhaps also in beds of coal, only partially consolidated at the time.

There is an extensive bituminous limestone formation in Persia, containing 20 per cent. of bitumen, and the theory elaborated in the paper would account for bitumen and oil having been found in Canada and Tennessee embedded in limestone, which fact is cited by Mr. Peckham as favoring his belief that some petroleums are a “product of the decomposition of animal remains.”

Above all, this theory accounts for the many varieties in the chemical composition of paraffin oils in accordance with ordinary operations of nature during successive geological periods.—*Chem. News.*

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THE COLORADO DESERT LAKE.

Mr. J.J. Mcgillivray, who has been for many years in the United States mineral survey service, has some interesting things to say about the overflow of the Colorado desert, which has excited so much comment, and about which so many different stories have been told:

“None of the papers, so far as I know,” said Mr. McGillivray, “have described with much accuracy or detail the interesting thing which has happened in the Colorado desert or have stated how it happened. The Colorado desert lies a short distance northwest of

the upper end of the Gulf of California, and contains not far from 2,500 square miles. The Colorado River, which has now flooded it, has been flowing along to the east of it, emptying into the Gulf of California. The surface of the desert is almost all level and low, some of it below the sea level. Some few hundreds of years ago it was a bay making in from the Gulf of California,

Page 12

and then served as the outlet of the Colorado River. But the river carried a good deal of sediment, and in time made a bar, which slowly and surely shut off the sea on the south, leaving only a narrow channel for the escape of the river, which cut its way out, probably at some time when it was not carrying much sediment. Then the current became more rapid and cut its way back into the land, and, in doing this, did not necessarily choose the lowest place, but rather the place where the formation of the land was soft and easily cut away by the action of the water.

“While the river was cutting its way back it was, of course, carrying more or less sediment, and this was left along the banks, building them all the time higher, and confining the river more securely in its bounds. That is the Colorado River as we have known it ever since its discovery. Meantime, the water left in the shallow lake, cut off from the flow of the river, gradually evaporated—a thing that would take but a few years in that country, where the heat is intense and the humidity very low. That left somewhere about 2,000 miles of desert land, covered with a deposit of salt from the sea water which had evaporated, and most of it below the level of the sea. That is the Colorado desert as it has been known since its discovery.

“Then, last spring, came the overflow which has brought about the present state of affairs. The river was high and carrying an enormous amount of sediment in proportion to the quantity of water. This gradually filled up the bed of the stream and caused it to overflow its banks, breaking through into the dry lake where it had formerly flowed. The fact that the water is salt, which excited much comment at the time the overflow was first discovered, is, of course, due to the fact that the salt in the sea water which evaporated hundreds of years ago has remained there all the time, and is now once more in solution.

“The desert will, no doubt, continue to be a lake and the outlet of the river unless the breaks in the banks of the river are dammed by artificial means, which seems hardly possible, as the river has been flowing through the break in the stream 200 feet wide, four feet deep, and flowing at a velocity of five feet a second.

“It is an interesting fact to note that the military survey made in 1853 went over this ground and predicted the very thing which has now happened. The flooding of the desert will be a good thing for the surrounding country, for it does away with a large tract of absolutely useless land, so barren that it is impossible to raise there what the man in Texas said they mostly raised in his town, and it will increase the humidity of the surrounding territory. Nature has done with this piece of waste land what it has often been proposed to do by private enterprise or by public appropriation. Congress has often been asked to make an appropriation for that purpose.”

Mr. McGillivray had also some interesting things to say about Death Valley, which he surveyed.

Page 13

“It has been called a *terra incognita* and a place where no human being could live. Well, it is bad enough, but perhaps not quite so bad as that. The great trouble is the scarcity of water and the intense heat. But many prospecting parties go there looking for veins of ore and to take out borax. The richest borax mines in the world are found there. The valley is about 75 miles long by 10 miles wide. The lowest point is near the center, where it is about 150 ft. below the level of the sea. Just 15 miles west of this central point is Telescope peak, 11,000 ft. above the sea, and 15 miles east is Mt. Le Count, in the Funeral mountains, 8,000 ft. high. The valley runs almost due north and south, which is one reason for the extreme heat. The only stream of water in or near the valley flows into its upper end and forms a marsh in the bed of the valley. This marsh gives out a horrible odor of sulphureted hydrogen, the gas which makes a rotten egg so offensive. Where the water of this stream comes from is not very definitely known, but in my opinion it comes from Owen’s lake, beyond the Telescope mountains to the west, flowing down into the valley by some subterranean passage. The same impurities found in the stream are also found in the lake, where the water is so saturated with salt, boracic acid, *etc*., that one can no more sink in it than in the water of the Great Salt lake; and I found it so saturated that after swimming in it a little while the skin all over my body was gnawed and made very sore by the acids. Another reason why I think the water of the stream enters the valley by some fixed subterranean source is the fact that, no matter what the season, the flow from the springs that feed the marsh is always exactly the same.

“The heat there is intense. A man cannot go an hour without water without becoming insane. While we were surveying there, we had the same wooden cased thermometer that is used by the signal service. It was hung in the shade on the side of our shed, with the only stream in the country flowing directly under it, and it repeatedly registered 130 deg.; and for 48 hours in 1883, when I was surveying there, the thermometer never once went below 104 deg..”—*Boston Herald.*

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HEMLOCK AND PARSLEY.

By W.W. BAILEY.

The study of the order Umbelliferae presents peculiar difficulties to the beginner, for the flowers are uniformly small and strikingly similar throughout the large and very natural group. The family distinctions or features are quite pronounced and unmistakable, and it is the determination of the genera which presents obstacles—serious, indeed, but not insurmountable. “By their fruits shall ye know them.”

Page 14

The Umbelliferae, as we see them here, are herbaceous, with hollow, often striated stems, usually more or less divided leaves, and no stipules. Occasionally we meet a genus, like Eryngium or Hydrocotyle, with leaves merely toothed or lobed. The petioles are expanded into sheaths; hence the leaves wither on the stem. The flowers are usually arranged in simple or compound umbels, and the main and subordinate clusters may or may not be provided with involucres and involucels. To this mode of arrangement there are exceptions. In marsh-penny-wort (Hydrocotyle) the umbels are in the axils of the leaves, and scarcely noticeable; in Eryngium and Sanicula they are in heads. The calyx is coherent with the two-celled ovary, and the border is either obsolete or much reduced. There are five petals inserted on the ovary, and external to a fleshy disk. Each petal has its tip inflexed, giving it an obcordate appearance. The common colors of the corolla are white, yellow, or some shade of blue. Alternating with the petals, and inserted with them, are the five stamens.

The fruit, upon which so much stress is laid in the study of the family, is compound, of two similar parts or carpels, each of which contains a seed. In ripening the parts separate, and hang divergent from a hair-like prolongation of the receptacle known as the gynophore. Each half fruit (mericarp) is tipped by a persistent style, and marked by vertical ribs, between or under which lie, in many genera, the oil tubes or vittae. These are channels containing aromatic and volatile oil. In examination the botanist makes delicate cross sections of these fruits under a dissecting microscope, and by the shape of the fruit and seed within, and by the number and position of the ribs and oil tubes, is able to locate the genus. It, of course, requires skill and experience to do this, but any commonly intelligent class can learn the process. It goes without saying, and as a corollary to what has already been stated, that these plants should always be collected in full fruit; the flowers are comparatively unimportant. Any botanist would be justified in declining to name one of the family not in fruit. An attempt would often be mere guesswork.

In this family is found the poison hemlock (Conium) used by the ancient Greeks for the elimination of politicians. It is a powerful poison. The whole plant has a curious mousy odor. It is of European origin. Our water hemlock is equally poisonous, and much more common. It is the *Cicuta maculata* of the swamps—a tall, coarse plant which has given rise to many sad accidents. *AEthusa cynapium*, another poisonous plant, known as “fool’s parsley,” is not uncommon, and certainly looks much like parsley. This only goes to show how difficult it is for any but the trained botanist to detect differences in this group of plants. Side by side may be growing two specimens, to the ordinary eye precisely alike, yet the one will be innocent and the other poisonous.

Page 15

The drug asafetida is a product of this order. All the plants appear to “form three different principles: the first, a watery acid matter; the second, a gum-resinous milky substance; and the third, an aromatic, oily secretion. When the first of these predominates they are poisonous; the second in excess converts them into stimulants; the absence of the two renders them useful as esculents; the third causes them to be pleasant condiments.” So that besides the noxious plants there is a long range of useful vegetables, as parsnips, parsley, carrots, fennel, dill, anise, caraway, cummin, coriander, and celery. The last, in its wild state, is said to be pernicious, but etiolation changes the products and renders them harmless. The flowers of all are too minute to be individually pretty, but every one knows how charming are the umbels of our wild carrot, resembling as they do the choicest old lace. Frequently the carrot has one central maroon colored floret.

Though most of the plants are herbs, Dr. Welwitsch found in Africa a tree-like one, with a stem one to two feet thick, much prized by the natives for its medicinal properties, and also valuable for its timber. In Kamschatka also they assume a sub-arboreous type, as well as on the steppes of Afghanistan.

As mistakes often occur by confounding the roots of Umbelliferae with those of horse radish or other esculents, it is well, when in doubt, to send the plants, *always in fruit*, if possible, for identification. None of them are poisonous to the touch—at least to ordinary people. Cases of rather doubtful authenticity are reported from time to time of injury from the handling of wild carrot. We have always suspected the proximity of poison ivy; still, it is unwise to dogmatize on such matters. Some people cannot eat strawberries—more’s the pity!—while the rest of us get along with them very happily. Lately the *Primula obconica* has acquired an evil reputation as an irritant, so there is no telling what may not happen with certain constitutions.

Difficult as is the study of Umbelliferae, it becomes fascinating on acquaintance. To hunt up a plant and name it by so scientific a process brings to the student a sufficient reward.—*American Naturalist.*

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THE EREMURI.

[Illustration: EREMURUS HIMALAICUS. (Flowers white.)]

It has often been a matter of astonishment to me that eremuri are not more frequently seen in our gardens. There are certainly very few plants which have a statelier or more handsome appearance during the summer months. Both in point of brightness of color and their general habit and manner of growth they are very much to be recommended. For some reason or other they have the character of being difficult plants, but they do

not deserve it at all, and a very slight attention to their requirements is enough to ensure success.

Page 16

They can stand a good many degrees of frost, and they ask for little more than a soil which has been deeply worked and well enriched with old rotten manure. Give them this, and they are certain to be contented with it, and the cultivator will be well rewarded for his pains. Only one thing should perhaps be added by way of precaution. If an eremurus appears too soon above ground, it is well just to cover it over with loose litter of some sort, so that it may not be nipped by spring frosts; and one experienced grower has said that it answers to lift them after blossoming, and to keep them out of the ground for a few weeks, so that they may be sufficiently retarded. But I have not yet been able to try this plan myself, and I do not speak from experience about it. My favorite is Eremurus Bungei, which I think is one of the handsomest plants I have in my garden. The clear yellow color of the blossom is so very good, and I like the foliage also; but of course it is not the most imposing by any means and if height and stateliness are especially regarded, E. robustus or E. robustus nobilis would carry off the palm. This commonly rises to the height of eight or nine feet above the ground, and on one occasion I have known it to be greatly in excess even of that; but such an elevation cannot be attained for more than a single year, and it afterward is contented with more moderate efforts. E. Himalaicus is of the purest possible white, and the spike is very much to be admired when it is seen at its best. It can be very easily raised from seed, but a good deal of patience is needed before its full glory has come. E. Olgae is the last of all, and it shows by its arrival that summer is hastening on. It is of a peach-colored hue, and very pretty indeed. Altogether it is a pity that eremuri are not more commonly grown. I think they are certain to give great satisfaction, if only a moderate degree of attention and care be bestowed upon them.—*H. Ewbank, in The Gardeners' Magazine.*

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RAPHIDES, THE CAUSE OF THE ACRIDITY OF CERTAIN PLANTS.

By R.A. WEBER, Ph.D.

At the last meeting of the American Association for the Advancement of Science, Prof. W.R. Lazenby reported his studies on the occurrence of crystals in plants. In this report he expressed the opinion that the acridity of the Indian turnip was due to the presence of these crystals or raphides. This opinion was opposed by Prof. Burrill and other eminent botanists, who claimed that other plants, as the fuchsia, are not at all acrid, although they contain raphides as plentifully as the Indian turnip. Here the matter was allowed to rest.

The United States Dispensatory and other works on pharmacy ascribe the acridity of the Indian turnip to an acrid, extremely volatile principle insoluble in water, and alcohol, but

soluble in ether. Heating and drying the bulbs dissipates the volatiles principle, and the acridity is destroyed.

Page 17

At a recent meeting of Ohio State Microscopical Society this subject was again brought up for discussion. It was thought by some that the raphides in the different plants might vary in chemical composition, and thus the difference in their action be accounted for. This question the writer volunteered to answer.

Accordingly, four plants containing raphides were selected, two of which, the *Calla cassia* and Indian turnip, were highly acrid, and two, the *Fuchsia* and *Tradescantia*, or Wandering Jew, were perfectly bland to the taste.

A portion of each plant was crushed in a mortar, water or dilute alcohol was added, the mixture was stirred thoroughly and thrown upon a fine sieve. By repeated washing with water and decanting a sufficient amount of the crystals was obtained for examination. From the calla the crystals were readily secured by this means in a comparatively pure state. In the case of the Indian turnip the crystals were contaminated with starch, while the crystals from the fuschia and tradescantia were embedded in an insoluble mucilage from which it was found impossible to separate them. The crystals were all found to be calcium oxalate.

Having determined the identity in chemical composition of the crystals, it was thought that there might be a difference of form of the crystals in the various plants, from the fact that calcium oxalate crystallizes both in the tetragonal and the monoclinic systems. A laborious microscopic examination, however, showed that this theory also had to be abandoned. The fuchsia and tradescantia contained bundles of raphides of the same form and equally as fine as those of the acrid plants. At this point in the investigation the writer was inclined to the opinion that the acridity of the Indian turnip and calla was due to the presence of an acrid principle.

Since the works on pharmacy claimed that the active principle of the Indian turnip was soluble in ether, the investigation was continued in this direction. A large stem of the calla was cut into slices, and the juice expressed by means of a tincture press. The expressed juice was limpid and filled with raphides. A portion of the juice was placed into a cylinder and violently shaken with an equal volume of ether. When the ether had separated a drop was placed upon the tongue. As soon as the effects of the ether had passed away, the same painful acridity was experienced as is produced when the plant itself is tasted. This experiment seemed to corroborate the assumption of an acrid principle soluble in ether. The supernatant ether, however, was slightly turbid in appearance, a fact which was at first ignored. Wishing to learn the cause of this turbidity, a drop of the ether was allowed to evaporate on a glass slide. Under the microscope the slide was found to be covered with a mass of raphides. A portion of the ether was run through a Munktell filter. The filtered ether was clear, entirely free from raphides, and had also lost every trace of its acridity.

Page 18

The same operations were repeated upon the Indian turnip with exactly similar results.

These experiments show conclusively that the acridity of the Indian turnip and calla is due to the raphides of calcium oxalate only.

The question of the absence of acridity in the other two plants still remained to be settled. For this purpose some recent twigs and leaves of the fuchsia were subjected to pressure in a tincture press. The expressed juice was not limpid, but thick, mucilaginous and ropy. Under the microscope the raphides seemed as plentiful as in the case of the two acrid plants. When diluted with water and shaken with ether, there was no visible turbidity in the supernatant ether, and when a drop of the ether was allowed to evaporate on a glass slide, only a few isolated crystals could be seen. From this it will be seen that in this case the raphides did not separate from the mucilaginous juice to be held in suspension in the ether. A great deal of time and labor were spent in endeavoring to separate the crystals completely from this insoluble mucilage, but without avail. With the tradescantia similar results were obtained.

From these experiments the absence of acridity in these two plants, in spite of the abundance of raphides, may readily be explained by the fact that the minute crystals are surrounded with and embedded in an insoluble mucilage, which prevents their free movement into the tongue and surface of the mouth, when portions of the plants are tasted.

The reason why the Indian turnip loses its acridity on being heated can be explained by the production of starch paste from the abundance of starch present in the bulbs. This starch paste would evidently act in a manner similar to the insoluble mucilage of the other two plants.

So also it can readily be seen that when the bulbs of the Indian turnip have been dried, the crystals can no longer separate from the hard mass which surrounds them, and consequently can exert no irritant action when the dried bulbs are placed against the tongue.—*Jour. Am. Chem. Soc.*

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THE WHALE-HEADED STORK.

[Illustration: THE WHALE-HEADED STORK—BALAENICEPS REX.]

Of all the wonders that inhabit the vast continent of Africa, the most singular one is undoubtedly the *Balaeniceps*, or whale-headed stork. It is of relatively recent discovery, and the first description of it was given by Gould in the early part of 1851. It is at present still extremely rare. The Paris Museum possesses three specimens of it, and the Boulogne Museum possesses one. These birds always excite the curiosity of the

public by their strange aspect. At first sight, says W.P. Parker, in his notes upon the osteology of the balaeniceps, this bird recalls the boatbill, the heron, and the adjutant. Other birds, too, suggest themselves to the mind, such as

Page 19

the pelican, the toucan, the hornbills, and the podarges. The curious form of the bill, in fact, explains this comparison with birds belonging to so different groups, and the balaeniceps would merit the name of boatbill equally well with the bird so called, since its bill recalls the small fishing boats that we observe keel upward high and dry on our seashores. This bill is ten inches in length, and four inches in breadth at the base. The upper mandible, which is strongly convex, exhibits upon its median line a slight ridge, which is quite wide at its origin, and then continues to decrease and becomes sensibly depressed as far as to the center of its length, and afterward rises on approaching the anterior extremity, where it terminates in a powerful hook, which seems to form a separate part, as in the albatrosses. Throughout its whole extent, up to the beginning of the hook, this mandible presents a strong convexity over its edge, which is turned slightly inward. The lower mandible, which is powerful, and is indented at its point to receive the hook, has a very sharp edge, which, with that of the upper mandible, constitutes a pair of formidable shears. The color of the bill is pale yellow, passing to horn color toward the median ridge, and the whole surface is sprinkled with dark brown blotches. The nostrils are scarcely visible, and are situated in a narrow cleft at the base of the bill, and against the median ridge. The tongue is very small and entirely out of proportion to the vast buccal capacity. This is a character that might assimilate the balaeniceps to the pelican. The robust head, the neck, and the throat, are covered with slate-colored feathers verging on green, and not presenting the repulsive aspect of the naked skin of the adjutant. As in the latter, the skin of the throat is capable of being dilated so as to form a voluminous pouch. Upon the occiput the feathers are elongated and form a small crest. The body is robust and covered upon the back with slate-colored feathers bordered with ashen gray. Upon the breast the feathers are lanceolate, and marked with a dark median stripe. Finally, the lower parts, abdomen, sides, and thighs, are pale gray, and the remiges and retrices are black. According to Verreaux, the feathers of the under side of the tail are soft and decompounded, but at a distance they only recall the beautiful plumes of the adjutant. The well-developed wings indicate a bird of lofty flight, yet of all the bones of the limbs, anterior as well as posterior, the humerus alone is pneumatized. The strong feet terminate in four very long toes deprived at the interdigital membrane observed in most of the Ciconidae. The claws are powerful and but slightly curved, and that of the median toe is not pectinated as in the herons.

Page 20

The balaeniceps is met with only in or near water, but it prefers marshes to rivers. It is abundant upon the banks of the Nile only during the hot season which precedes the rains and when the entire interior is dried up. During the rest of the year it inhabits natural ponds and swamps, where the shallow water covers vast areas and presents numerous small islands, of easier access than the banks of the Nile, which always slope more or less abruptly into deep water. In such localities it is met with in pairs or in flocks of a hundred or more, seeking its food with tireless energy, or else standing immovable upon one leg, the neck curved and the head resting upon the shoulder. When disturbed, the birds fly just above the surface of the water and stop at a short distance. But when they are startled by the firing of a gun, they ascend to a great height, fly around in a circle and hover for a short time, and then descend upon the loftiest trees, where they remain until the enemy has gone.

Water turtles, fish, frogs and lizards form the basis of their food. According to Petherick, they do not disdain dead animals, whose carcasses they disembowel with their powerful hooked beak. They pass the night upon the ground, upon trees and upon high rocks. As regards nest-making and egg-laying, opinions are most contradictory. According to Verreaux, the balaeniceps builds its nest of earth, vegetable debris, reeds, grass, *etc*., upon large trees. The female lays two eggs similar to those of the adjutant. It is quite difficult to reconcile this opinion with that of Petherick, who expresses himself as follows: “The balaeniceps lays in July and August, and chooses for that purpose the tall reeds or grasses that border the water or some small and slightly elevated island. They dig a hole in the ground, and the female deposits her eggs therein. I have found as many as twelve eggs in the same nest.”

The whale-headed stork is still so little known that there is nothing in these contradictions that ought to surprise us. Authors are no more in accord on the subject of the affinities of this strange bird. Gould claims that it presents the closest affinities with the pelican and is the wading type of the Pelicanidae. Verreaux believes that its nearest relative is the adjutant, whose ways it has, and that it represents in this group what the boatbill represents in the heron genus. Bonaparte regards it as intermediate between the pelican and the boatbill. If we listen to Reinhurdt, we must place it, not alongside of the boatbill, but alongside of the African genus Scopus. The boatbill, says he, is merely a heron provided with a singular bill, which has but little analogy with that of the balaeniceps, and not a true resemblance. The nostrils differ in form and position in those two birds, and in the boatbill there exists beneath the lower mandible a dilatable pouch that we do not find in the balaeniceps. An osteological examination leads Parker to place the balaeniceps near the boatbill, and the present classification is based upon that opinion. The family of Ardeidae is, therefore, divided into five sub-families, the three last of which each comprises a single genus.

Page 21

Ardeidae.—Ardeineae (herons).
Botaurineae (bitterns).
Scopineae (ombrette).
Cancomineae (boatbill).
Balaenicepineae (whale-headed stork).

All the whale-headed storks that have been received up to the present have come from the region of the White Nile; but Mr. H. Johnston, who traveled in Congo in 1882, asserts that he met with the bird on the River Cunene between Benguela and Angola, where it was even very common. Mr. Johnston's assertion has been confirmed by other travelers worthy of credence, but, unfortunately, the best of all confirmations is wanting, and that is a skin of this magnificent wader. We can, therefore, only make a note of Mr. Johnston's statement, and hope that some traveler may one day enrich our museums with some balaeniceps from these regions. The presence of this bird in the southwest of Africa is, after all, not impossible; yet there is one question that arises: Was the balaeniceps observed by Mr. Johnston of the same species as that of the White Nile, or was it a new type that will increase this family, which as yet comprises but one genus and one species—the *Balaeniceps rex*?—*Le Naturaliste*.

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THE CALIFORNIA RAISIN INDUSTRY.

Fresno County, for ten miles about Fresno, furnishes the best example of the enormous increase in values which follows the conversion of wheat fields and grazing land into vineyards and orchards. Not even Riverside can compare with it in the rapid evolution of a great source of wealth which ten years ago was almost unknown. What has transformed Fresno from a shambling, dirty resort of cowboys and wheat ranchers into one of the prettiest cities in California is the raisin grape. Though nearly all fruits may be grown here, yet this is pre-eminently the home of the raisin industry, and it is the raisin which in a single decade has converted 50,000 acres of wheat fields into vineyards. No other crop in California promises such speedy returns or such large profits as the raisin grape, and as the work on the vineyards is not heavy, the result has been a remarkable growth of the infant industry. It is estimated that in this county, which contains 5,000,000 acres and is nearly as large as Massachusetts, there are 400,000 acres that may be irrigated and are specially adapted to the grape. As the present crop on about 25,000 acres in full bearing is valued at $6,000,000, some idea may be formed of the revenue that will come to the Fresno vineyardists when all this choice valley land is planted and in full bearing. And what makes the prospect of permanent prosperity surer is the fact that nine out of ten new settlers are content with twenty-acre tracts, as one of these is all which a man can well care for, while the income from this little vineyard will average $4,000 above all expenses, a larger income than is enjoyed by three-quarters of the professional men throughout the country.

Page 22

The raisin industry in California is very young. To be sure, dried grapes have been known since the time of the Mission Fathers, but the dried mission grape is not a raisin. The men who thirty years ago sent over to Europe for the choicest varieties of wine grapes imported among other cuttings the Muscatel, the Muscat of Alexandria, and the Feher Zagos; the three finest raisin grapes of Spain. But the raisin, like the fig, requires skillful treatment, and for years the California grower made no headway. He read all that had been written on the curing of the raisin; several enterprising men went to Spain to study the subject at first hand; but despite all this no progress was made. Finally several of the pioneer raisin men of Fresno cut loose from all precedent, dried their grapes in the simple and natural manner and made a success of it. From that time, not over ten years ago, the growth of the industry has eclipsed that of every other branch of horticulture in the State, and the total value of the product promises soon to exceed the value of the orange crop or the yield of wine and brandy.

It required a good deal of nerve for the pioneers of Fresno County to spend hundreds of thousands of dollars in bringing water upon what the old settlers regarded as a desert, fit only to grow wheat in a very wet season. In other parts of the State the Mission Fathers had dug ditches and built aqueducts, so that the settlers who came after them found a well devised water system, which they merely followed. But in Fresno no one had ever tried to grow crops by irrigation. When Fremont came through there from the mountains he found many wild cattle feeding on the rank grass that grew as high as the head of a man on horseback. The herds of the native Californians were almost equally wild. The country was one vast plain which in summer glowed under a sun that was tropical in its intensity. As late as 1860 one could travel for a day without seeing a house or any sign of habitation. The country was owned by great cattle growers, who seldom rode over their immense ranches, except at the time of the annual “round-up” of stock. About thirty years ago a number of large wheat growers secured big tracts of land around Fresno. At their head was Isaac Friedlander, known as the wheat king of the Pacific Coast. Friedlander would have transformed this country had not financial ruin overcome him. His place was taken by others, like Chapman, Easterby, Eisen and Hughes—men who believed in fruit growing and who had the courage to carry on their operations in the face of repeated failures.

Page 23

The great development of Fresno has been due entirely to the colony system, which has also built up most of the flourishing cities of Southern California. In 1874 the first Fresno colony was started by W.S. Chapman. He cut up six sections of land into 20-acre tracts, and brought water from King's River. The colonists represented all classes of people, and though they made many disastrous experiments, with poor varieties of grapes and fruit, still there is no instance of failure recorded, and all who have held on to their land are now in comfortable circumstances. Some of the settlers in this colony were San Francisco school teachers. They obtained their 20-acre tracts for $400, and many of them retired on their little vineyards at the end of five or six years. One lady, named Miss Austen, had the foresight to plant all her property in the best raisin grapes, and for many years drew a larger annual revenue from the property than the whole place cost her. The central colony now has an old established look. The broad avenues are lined with enormous trees; many of the houses are exceedingly beautiful country villas. What a transformation has been wrought here may be appreciated when it is said that 150 families now produce $400,000 a year on the same land which twenty years ago supported but one family, which had a return of only $35,000 from wheat. The history of this one colony of six sections of old wheat land is the key to Fresno's prosperity. It proves better than columns of argument, or facts or figures, the immense return that careful, patient cultivation may command in this home of the grape. Near this colony are a half-dozen others which were established on the same general plan. The most noteworthy is the Malaga colony, founded by G.G. Briggs, to whom belongs the credit of introducing the raisin grape into Fresno.

Fresno City is the center from which one may drive in three directions and pass through mile after mile of these colonies, all showing signs of the wealth and comfort that raisin making has brought. Only toward the west is the land still undeveloped, but another five years promise to see this great tract, stretching away for twenty miles, also laid out in small vineyards and fruit farms. Fresno is the natural railroad center of the great San Joaquin Valley. It is on the main line of the Southern Pacific and is the most important shipping point between San Francisco and Los Angeles. The new line of the Santa Fe, which has been surveyed from Mojave up through the valley, passes through Fresno. Then there are three local lines that have the place for a terminus, notably the mountain railway, which climbs into the Sierra, and which it is expected will one day connect with the Rio Grande system and give a new transcontinental line. Here are also building round houses and machine shops of the Southern Pacific Company. These, with new factories, packing houses, and other improvements, go far to justify the sanguine expectations

Page 24

of the residents. There has never been a boom in Fresno, but a high railroad official recently, in speaking of the growth of the city, said: “Fresno in five years will be the second city in California.” This prediction he based on the wonderful expansion of its resources in the last decade and the substantial character of all the improvements made. It is a pretty town, with wide, well-paved streets, handsome modern business blocks, and residence avenues that would do credit to any old-settled town of the East. The favorite shade tree is the umbrella tree, which has the graceful, rounded form of the horse chestnut, but with so thick a foliage that its shadow is not dappled with sunlight. Above it is an intensely dark green, while viewed from below it is the most delicate shade of pea green. Rivaling this in popularity is the pepper tree, also an evergreen, and the magnolia, fan palm, eucalyptus, or Australian blue gum, and the poplar. All these trees grow luxuriantly. It has also become the custom in planting a vineyard to put a row of the white Adriatic fig trees around the place, and to mark off ten or twenty acre tracts in the same way. The dark green foliage of the fig is a great relief to the eye when the sun beats down on the sandy soil. Leading out of Fresno are five driveways. The soil makes a natural macadam, which dries in a few hours. Throughout the year these roads are in good condition for trotting, and nearly every raisin grower is also an expert in horseflesh, and has a team that will do a mile in less than 2:30. The new race course is one of the finest in the State. Toward the west from Fresno has recently been opened a magnificent driveway, which promises in a few years to rival the Magnolia ave. of Riverside. This is called Chateau Fresno ave. It has two driveways separated by fan palms and magnolias, while along the outer borders are the same trees with other choice tropical growths, that will one day make this avenue well worth traveling many miles to see. This is the private enterprise of Mr. Theodore Kearney, who made a fortune in real estate, and it is noteworthy as an illustration of the large way in which the rich Californian goes about any work in which he takes an interest. Probably the finest avenue in Fresno is the poplar-lined main driveway through the Barton vineyard. It is a mile in length, and the trees, fully fifty feet high, stand so thickly together that when in full leaf they form a solid wall of green. The vineyard, which is a mile square, is also surrounded by a single row of these superb poplars.

A visit to one of the great raisin vineyards near Fresno is a revelation in regard to the system that is necessary in handling large quantities of grapes. The largest raisin vineyard in the State, if not in the world, is that of A.B. Butler. It comprises 640 acres, of which a trifle over 600 acres is planted to the best raisin grapes. Butler was a Texas cowboy, and came to Fresno with very little capital.

Page 25

He secured possession of a section of land, planted it to grapes; he read everything he could buy on raisin making, but found little in the books that was of any value. So he made a trip to Spain, and inspected all the processes in the Malaga district. He gathered many new ideas. One of the most valuable suggestions was in regard to prunings and keeping the vine free from the suckers that sap its vitality. When he returned from this trip and passed through Los Angeles County he saw that the strange disease which was killing many hundred acres of vines was nothing else than the result of faulty prunings—the retention of suckers until they gained such lusty growth that their removal proved fatal to the vine. His vineyard is as free from weeds and grass as a corner of a well kept kitchen garden. The vine leaves have that deep glossy look which betrays perfect health. When my visit was made the whole crop was on trays spread out in the vineyard. These trays had been piled up in layers of a dozen—what is technically known as boxed—as a shower had fallen the previous night, and Mr. Butler was uncertain whether he would have a crop of the choicest raisins or whether he would have to put his dried grapes in bags, and sell them for one-third of the top price. Fortunately the rain clouds cleared away. The crop was saved and the extreme hot weather that followed made the second crop almost as valuable as the first.

The method of drying and packing the raisin is peculiar and well worth a brief description. When the grape reaches a certain degree of ripeness and develops the requisite amount of saccharine matter a large force is put into the vineyard and the picking begins. The bunches of ripe grapes are placed carefully on wooden trays and are left in the field to cure. The process requires from seven days to three weeks, according to the amount of sunshine. This climate is so entirely free from dew at night that there is no danger of must. The grape cures perfectly in this way and makes a far sweeter raisin than when dried by artificial heat. When the grapes are dried sufficiently the trays are gathered and stacked in piles about as high as a man’s waist. Then begins the tedious but necessary process of sorting into the sweat boxes. These boxes are about eight inches deep and hold 125 pounds of grapes. Around the sorter are three sweat boxes for the three grades of grapes. In each box are three layers of manila paper which are used at equal intervals to prevent the stems of the grapes from becoming entangled, thus breaking the fine large bunches when removed. The sorter must be an expert. He takes the bunches by the stem, placing the largest and finest in the first grade box, those which are medium sized in the second grade, and all broken and ragged bunches in the third class. When the boxes are filled they are hauled to the brick building known as the equalizer. This is constructed so as to permit ventilation at the top, but to exclude light and air as much as possible from the grapes. The boxes are piled in tiers in this house and allowed to remain in darkness for from ten to twenty days. Here they undergo a sweating process, which diffuses moisture equally throughout the contents of each box. This prevents some grapes from retaining undue moisture, and it also softens the stems and makes them pliable.

Page 26

From the equalizing room the sweat boxes are taken to the packing room. Here they are first weighed. The first and second grades are passed to the sorter, while the third grade raisins are placed in a big machine that strips off the stems and grades the loose raisins in three or four sizes. These are placed in sacks and sold as loose raisins. The higher grades are carefully sorted into first and second class clusters. After this sorting the boxes are passed to women and girls, who arrange the clusters neatly in small five pound boxes with movable bottoms. These boxes are placed under slight pressure, and four of them fill one of the regular twenty pound boxes of commerce. The work of placing the raisins in the small boxes requires much practice, but women are found to be much swifter than men at this labor, and, as they are paid by the box, the more skillful earn from $2 to $3 a day. It is light, pleasant work, as the room is large, cool and well ventilated, and there is no mixing of the sexes, such as may be found in many of the San Francisco canneries. For this reason the work attracts nice girls, and one may see many attractive faces in a trip through a large packing house. One heavy shouldered, masculine-looking German woman, who, however, had long, slender fingers, was pointed out as the swiftest sorter in the room. She made regularly $3 a day. The assurance of steady work of this kind for three months draws many people to Fresno, and the regular disbursement of a large sum as wages every week goes far to explain the thrift and comfort seen on every hand.

The five pound boxes of grapes are passed to the pressing machine, where four of them are deftly transferred to a twenty pound box. The two highest grades of raisins are the Dehesa and the London layers. It has always been the ambition of California's raisin makers to produce the Dehesa brand. They know that their best raisins are equal in size and quality to the best Spanish raisins, but heretofore they have found the cost of preparing the top layer in the Spanish style very costly, as the raisins had to be flattened out (or thumbed, as it is technically called) by hand. In Spain, where women work for 20 cents a day, this hand labor cuts no figure in the cost of production, but here, with the cheapest labor at $1.50 a day, it has proved a bar to competition. American ingenuity, however, is likely to overcome this handicap of high wages. T.C. White, an old raisin grower, has invented a packing plate of metal, with depressions at regular intervals just the size of a big raisin. This plate is put at the bottom of the preliminary packing box, and when the work of packing is complete the box is reversed and the top layer, pressed into the depressions of the plate, bears every mark of the most careful hand manipulation. Mr. Butler used this plate for the first time this season, and found it a success, and there is no question of its general adoption. Every year sees more attention paid to the careful

Page 27

grading of raisins, as upon this depends much of their marketable value. The large packing houses have done good work in enforcing this rule, and the chief sinners who still indulge in careless packing are small growers with poor facilities. Probably the next few years will see a great increase in the number and size of the packing houses which will prepare and market most of Fresno's raisin crop. The growers also will avail themselves of the co-operative plan, for which the colony system offers peculiar advantages.

Geometrical progression is the only thing which equals the increase of Fresno's raisin product. Eighteen years ago it was less than 3,000 boxes. Last year it amounted to 1,050,000 boxes, while this year the product cannot fall below 1,250,000 boxes. New vineyards are coming into bearing every year, and this season has seen a larger planting of new vineyards than ever before. This was due mainly to the stimulus and encouragement of the McKinley bill, which was worth an incalculable sum to those who are developing the raisin industry in California. Besides raisins, Fresno produced last year 2,500,000 gallons of wine, a large part of which was shipped to the East. The railroad figures show the wealth that is produced here every year from these old wheat fields. The dried fruit crop last year was valued at $1,123,520; raisins, $1,245,768; and the total exports were $8,957,899.

The largest bearing raisin vineyard in Fresno is that of A.B. Butler, who has over 600 acres in eight year-old vines. The pack this year will be fully 120,000 boxes. As each box sells for an average of $1.75, the revenue from this vineyard will not fall far below a quarter of a million. One of the finest places in the county is Colonel Forsythe's 160-acre vineyard, from which 40,000 boxes are packed. Forsythe has paid so much attention to the packing of his raisins that his output commands a fancy price. This year he wanted to go to Europe, so he sold his crop on the vines to a packing house, receiving a check for $20,000. These, of course, are the great successes, but nearly every small raisin grower has made money, for it costs not over 11/2 cents per pound to produce the raisin, and the price seldom falls below 6 cents per pound. Good land can be secured in Fresno at from $50 to $200 per acre. The average is $75 an acre for first-class raisin land that is within ten miles of any large place. It costs $75 an acre to get a raisin vineyard into bearing. In the third year the vines pay for cultivation, and from that time on the ratio of increase is very large. Much of the work of pruning, picking, and curing grapes is light, and may be done by women and children. The only heavy labor about the vineyard is the plowing and cultivating. Fresno is a hot place in the summer, the mercury running up to 110 degrees in the shade, but this is a dry heat, which does not enervate, and, with proper protection for the head, one may work in the sun all day, without any danger of sunstroke.

Page 28

The colony system, which has been brought to great perfection around Fresno, permits a family of small means to secure a good home without much capital to start with. Where no money is paid for labor, a vineyard may be brought to productiveness with very small outlay. At the same time there is so great a demand for labor in the large vineyards, that the man who has a five or ten acre tract may be sure of work nearly all the year. In some places special inducements have been held out to people of small means to secure a five-acre vineyard while they are at work in other business. One colony of this sort was started eighteen months ago near Madera, in Fresno County. A tract of 3,000 acres was planted to Muscat grapes, and then sold out in five and ten acre vineyards, on five years' time, the purchaser paying only one-fifth cash. The price of the land was $75 an acre, and it was estimated that an equal sum per acre would put the vineyard into full bearing. Thus, for $750, or, with interest, for $1,000, a man working on a small salary in San Francisco will have in five years a vineyard which should yield him a yearly revenue of $500. From the present outlook there can be no danger of over-production of raisins, any more than of California wine or dried fruits. The grower is assured of a good market for every pound of raisins he produces, and the more care he puts into the growing and packing of his crop, the larger his returns will be. For those who love life in the open air, there is nothing in California with greater attractions than raisin growing in Fresno County.—*N.Y. Tribune.*

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COLD AND MORTALITY.

By Dr. B.W. RICHARDSON.

During the seven weeks of extreme atmospheric cold in which the last year ended and with which the present year opened, every one has been startled by the mortality that has prevailed among the enfeebled and aged population. Friends have been swept away in a manner most painful to recall, under the influence of an external agency, as natural as it is fatal in its course, and over which science, as yet, holds the most limited control.

In the presence of these facts questions occur to the mind which have the most practical bearing. Why should a community wake up one day with catarrh or with the back of the throat unduly red and the tonsils large? Why, in a particular village or town, shall the medical men be summoned on some particular day to a number of places to visit children with croup? What is the reason that cases of sudden death, by so-called "apoplexy," crowd together into a few hours? Why, in a given day or week, are shoals of the aged swept away, while the young live as before? These are questions which curative and preventive medicine have not yet mastered as might be desired. Curative medicine, at the name of them, too often stands abashed, if her interpreter be honest;

and preventive medicine says, if her interpreter be honest, “The questions wait as yet for full interpretation.”

Page 29

Still, we are not altogether ignorant; some circumstances appear to be followed by effects so definite, that we may almost consider we have before us, in true position, cause and effect. Let us look at this position in reference to *the simple influence of temperature on the value of life*.

If we observe the fluctuation of the thermometer by the side of the mortality of the nation at large, no calculable relationship seems, at first sight, to be traceable between the one and the other. But if, in connection with the mortality, care be taken to isolate cases, and to divide them into groups according to the ages of those who die, a singular and significant series of facts follow, which show that after a given age a sudden decline of the temperature influences mortality by what may be considered a definite law. The law is, that variations of temperature exert no marked influence on the mortality of the population under the age of thirty years; but after the age of thirty is reached, a fall of temperature, sufficient to cause an increased number of deaths, acts in a regular manner, as it may be said, in waves or lines of intensity, according to the ages of the people. If we make these lines nine years long, we discover that they double in effect at each successive point. Thus, if the, fall in the temperature be sufficient to increase the mortality at the rate of one person of the age of thirty, the increase will run as follows: 1 death at 30 years of age will become 2 deaths at 39 years of age, 4 at 48 years, 8 at 57 years, 16 at 66 years, 33 at 75 years, and 64 at 84 years.

In these calculations nothing seems to be wanting that should render them trustworthy; they resulted from inquiries conducted on the largest scale; they were computed by one of our greatest authorities in vital statistics, the late Dr. William Farr, and they accord with what we gather from common daily observation. They supply, in a word, the scientific details and refinements of a rough estimate founded on universal experience, and they lead us to think very gravely on many subjects which may not have occurred to us before, and which are as curious as they are important.

We often hear persons who know little about vital phenomena, by which term I mean nothing mysterious, but simply the physics embraced in those phenomena which we connect with form and motion under the term life, harping on the one string, that man knows nothing of the laws of life and death. But what an answer to such presumption do the facts rendered above supply. Life and death are here reduced, on given conditions, to reasonings as clear and positive as are the reasonings on the development of heat by the combustion of fuel. It is not necessary for the vital philosopher to go out into the towns and villages to take a new census of deaths to enable him to give us his readings of the general mortality under the conditions specified. He may sit in his cabinet, and, as he reads his thermometer

Page 30

day by day, predict results. There is a fall of temperature that shall be known by experience to be sufficiently deep and prolonged to cause an increase of one death among those members of the community who have reached thirty years. Then, rising by a definite rule, there have died sixty-four, in proportion to that one, of those who have reached eighty-four years. This is sound calculation, and it leads to reflection. It leads one to ask, what, if the law be so definite, are curative and preventive medicine doing meanwhile, that they shall not disturb it? I fear that they hardly produce perturbations, and I do not see why they should; because, as the truth opens itself to the mind, the tremendous external change in the forces of the universe that leads to the result, is not to be grappled with nor interfered with by any specific method of human invention. The cause is too general, too overwhelming, too grasping. It is like the lightning stroke in its distance from our command; but it is widely spread, not pointed and concentrate; prolonged, not instantaneous; and, by virtue of these properties, is so much the more subtile and devastating.

At first it seems easy to explain the reason why a sudden fall in temperature should lead to an increase in the number of deaths, and it is to be admitted that, to a certain extent, the reason is clear.

ANIMAL POWER AT DIFFERENT PERIODS OF LIFE.

Without entering on the question whether heat is the animating principle of all living organisms, we may accept that in the evolution of heat in the body we have a measurement of the capacity of the body to sustain motion, which is only another phrase for expressing the resistance of the body to death. For example, if we assume that a healthy man of thirty respires sufficient air per day to produce as much heat as would raise fifty pounds of water at 32 deg. Fahr. to 212 deg. Fahr., and if we assume that a man of sixty in the same temperature is only able to respire so much air as shall cause him to evolve so much heat as would raise forty pounds of water from 32 deg. to 212 deg., we see a general reason why the older man should feel an effect from a sudden change in the temperature of the air which the younger would not feel; and if we assume, further, that a man of eighty could in the same time produce as much heat as would raise only twenty pounds of water from 32 deg. to 212 deg., we see a good reason why the oldest should suffer more from a decrease of external temperature than the other two. It is necessary, however, to know more than this general statement of an approximate fact; we ought to understand the method by which the reduction of temperature influences, and the details of the physiological process connected with the phenomena. When a human body is living after the age when the period of its growth is completed and before the period of its decay has commenced, it produces, when it is

Page 31

quite healthy, by its own chemical processes, so much heat or force as shall enable it, within given bounds, (1) to move its own machinery; (2) to call forth, at will, a limited measure of extra force which has been lying latent in its organism; and (3) to supply a fluctuating loss that must be conveyed away by contact with the surrounding air, by the earth, and by other bodies that it may touch, and which are colder than itself. There is thus produced in the body, *applied* force, *reserve* force, and *waste* force, and these distributions of the whole force generated, when correctly applied, maintain the perfect organism in such balance that life is true and steady. So much active force carries with it the power to perform so much labor; so much reserve force carries with it the power to perform a measure of new or extra labor to meet emergencies; so much waste force enables the body to resist the external vicissitudes without trenching on the supply that is always wanted to keep the heart pulsating, the chest breathing, the glands secreting or excreting, the digestive apparatus moving, and the brain thinking or absorbing.

Let us, even in the prime of manhood, disturb the distribution of force ever so little, and straightway our life, which is the resultant of force, is disturbed. If we use the active force too long, we become exhausted, and call on the reserve; if we continue the process, the result is failure more or less perfect, sleep, and, in the end, the last long sleep. Let us, instead of exhausting the force, cut it off at the sources where it is generated; let us remove the carbon or coal that should go in as fuel food, and we create prostration, and in continuance a waning animal fire, sleep, and death; or let us, instead of removing or withdrawing the supply of fuel, cut off the supply of air, as by immersion of the body in water, or by making it breathe a vapor that weakens the combination of oxygen with carbon—such a vapor as chloroform—and again we produce, at once, prostration, sleep, or death, according to the extent to which we have conducted the process. Lastly, if instead of using up unduly the active and reserve force, or of suppressing the evolution of force by the withdrawal of its sources, we expose the body to such an external temperature that it is robbed of its heat faster than it can generate it; if to supply the waste heat we draw upon the active and reserve forces, we call forth immediately the same condition as would follow extreme over-exertion, or suppression of the development of force; we call forth exhaustion and sleep, and, if we go far enough, death.

Page 32

We have had in view, in the above description, a man in the prime of life, in the center of growth, and decay. In regard to the force of animation in him, let us look at him now retrospectively and prospectively. In the past his has been a growing, developing body, and in the course of development he has produced an excess of force commensurate with the demands of his growth; this has enabled him gradually to bear more fatigue and more exposure, without exhaustion, and even with ease, until he has reached his maximum. When he has stopped in development, when he stands on a fair level with the external forces that are opposed to him, then his own force, for a short time balanced, soon stands second in command. He feels cold more tenderly; if his rest be broken, the demand for artificial heat is more urgent; if he lose or miss food, he sinks quickly; and, returning to our facts, as to the influence of the external temperature on mortality, these are the reasons why a fall in the thermometer sweeps away our population according to age so ruthlessly and decisively.

If we analyze the facts further by the side of the diseases which kill the old, we find those diseases to be numerous in name, but all of two types. They are diseases which of themselves tend either to produce undue loss of force, or that tend to prevent the development of force at its origin. Thus affections which are accompanied with exhaustive loss of fluids from the body, such as diabetes, dropsies, and haemorrhages, are of the first class; affections in which due supply of air to the lungs is prevented are of the second class, especially bronchitis, a disease so commonly assigned as the cause of the deaths among the members of the aged and enfeebled population, that succeed immediately on an extreme fall of the thermometer.

FALL OF TEMPERATURE—MODE OF ACTION.

In what has been written above I have stated simply and in open terms the fact that the fall of temperature produces a specified series of results, by reducing the force of the living organism, and disposing it to die. We may from this point investigate, from a physiological point of view, the mode by which the effect is produced in the economy. How does the decline of temperature act? Is the process simple or compound?

EXTRACTION OF HEAT.

The process is compound, and into it there enter three elements. In the first place, the body is robbed rapidly of its waste force, and the reserve and active elements of force are, consequently, called upon to the depression of the organism altogether. This obtains because the medium surrounding the body, the air, unless it be artificially heated, removes from its contact with the body a larger proportion of heat than can be spared; and it might be possible to produce such an influence on the body by sudden extraction of its heat as to destroy it at once by the mere act.

Page 33

If a man could be surrounded with frozen mercury he would die instantaneously, as from shock, by the immediate extraction of his heat. But in ordinary cases, and under ordinary circumstances, the mere rapid extraction of waste heat is not sufficient to account for all the mischief produced by a low temperature; for by artificial warmth and non-conducting garments, we counteract the influence, and that, too, in a manner which proves pretty successful. We may, therefore, leave this element of extraction of heat as a most important, but not as the sole, agent of evil.

SUPPRESSED OXIDATION.

The second element is the effect on the process of oxidation of blood under the influence of cold. We all are aware that if a portion of dead animal or vegetable matter be placed at a low temperature, it keeps for a considerable time; and we have evidence of dead animals which, clothed in thick ribbed ice, have been retained from putrefaction for centuries. Hence we say that cold is an antiseptic as alcohol is, and chloroform, and ammonia, and other similar bodies. Cold is an antiseptic then, but why? Because it prevents, even in the presence of a ferment, the union of oxygen gas with combustible matter. The molecules of oxygen, in order that they shall combine, and in their combination evolve heat, require to be distributed, and to be distributed by the form of motion known as heat; deprive them of this activity, and they come into communion with themselves, are attracted to each other, and lose to the extent of this attraction their power of combining with the molecules of other bodies for which they have an affinity. In an analogous, but more obvious way, we may see the same effect of motion in the microscopic examination of blood. In the blood, while it is circulating briskly in its vessels, there are distributed through it, without contact with each other, the millions of oxygen carriers called blood corpuscles. In the circulation in the free channels of the body, the arteries and veins, it is motion that keeps these corpuscles apart; we draw a drop of blood and let it come to rest on the microscope glass, and as the motion ceases the separated corpuscles run together, and adhere so firmly that we cannot easily separate them without their disintegration. If we were able to drive them in this state round the body, through the vessels, they would not combine readily with the tissues; they have, in fact, forfeited the condition necessary for such combination. So with the oxygen they carry; when its invisible molecules are deprived of the force called heat, which is motion, they do not readily combine with new matter. But perfect combination of oxygen and carbon in the blood is essential to every act of life. In the constant clash of molecule of oxygen with molecule of carbon in the blood lies the mainspring of all animal motion; the motion of the heart itself is secondary to that. Destroy that union, however slightly, and the balance is lost, and the animal body is, in a plain word, *ill*.

Page 34

Cold or decreased temperature, below a given standard, which for sake of comparison we may take at a mean of 40 deg. Fahr., reduces this combination of oxygen and carbon in blood. In my Lettsomian lectures to the Medical Society of London, delivered in 1860, I entered very fully into this subject, and illustrated points of it largely by experiment. Since then I have done more, and although I have not time here to state the details of these researches, I will epitomize the principal facts. I found then that, by exposing blood in chambers into which air can pass in and out, the blood could be oxidized at temperatures of 70 deg. if the distribution of air and blood were effectually secured, and I also found a proper standard of oxidation from a proper temperature. Afterward I proceeded to test for combination at lower temperatures, and discovered a gradually decreasing scale until I arrived at 40 deg. Fahr., when efficient combination ceased. Of course, my method was a very crude imitation of nature, but it was sufficient to show this fair and reliable result, that the oxidation of blood decreases as the temperature of the oxygen decreases.

From this point I went to animal life itself. I exposed animals to pure cold oxygen and to cold atmospheric air, and compared the results with other experiments in which animals of similar weight were exposed to warm air and warm oxygen. The facts gleaned were most important, for they proved conclusively that the products of combustion, that is to say, the products resulting from the union of oxygen and carbon, were reduced in proportion as the temperature of the oxygen was reduced. In the course of this inquiry another singular and instructive fact was elicited. It has been long known that at ordinary temperature, say 60 deg., pure neutral oxygen does not support animal life so well as oxygen that is diluted with nitrogen. In the nitrogen the molecules of oxygen are more freely distributed under the influence of motion, that is the meaning of the observed fact. What, then, would be the respective influence of low and high temperatures on the respiration of pure oxygen? To settle this question, animals of the same size and weight were placed in equal measures of oxygen gas and common air at a temperature of 30 deg. Fahr., and with the inevitable result that the animal in the pure oxygen ceased to respire one-third sooner than did the animal in common air. Carrying the inquiry further, I found that if the oxygen gas were warmed to 50 deg. Fahr., the respiration was continued six times as long as in the previous experiment, while if the warming were carried to 70 deg., it was sustained twenty-four times as long. I reversed the experiment; I made oxygen with cold produce anaesthetic sleep in a warm-blooded animal.

I need not carry this argument further; it is the easiest of the demonstrative facts of physiological science that reduction of temperature lessens the combining power of oxygen for blood, and therewith causes a reduction of animal force, and a tendency to arrest of that force, which, in the end, means *death*.

Page 35

MECHANICAL COLD.

The third element in the action of cold is more purely mechanical, and this, though in a sense secondary, is of immense import. When any body, capable of expansion by heat, that is to say, by radiant motion of its own particles, is reduced in temperature, it loses volume, contracts, or shrinks. The animal body is no exception to this rule; a ring that will fit tightly to the warm finger will fall off the same finger after exposure to cold. The whole of the soft parts shrink, and the vessels contract and empty themselves of their blood. Cold applied to the skin in an extreme degree blanches the skin, and renders it insensible and bloodless, so that if you prick it it does not bleed, neither does it feel. In cases where the body altogether is exposed to extreme cold this shrinking of the external parts is universal; the whole surface becomes pale and insensible; the blood in the small vessels superficially placed is forced inward upon the heart and vessels of the interior organs; the brain is oppressed with blood; sleep, or coma, as it is technically called, follows, and at last life is suspended.

In exposure to the lowest wave of temperature in this country these extreme effects are not commonly developed; but minor effects are brought out which are most significant. In particular, the effect on the lungs is strongly marked. The capillary vessels of the lungs, making up that fine network which plays over the computed six hundred millions of air vesicles, undergo paralysis when the cold air enters, and in proportion as such obstruction from this cause is decisive, the blood that should be brought to the air vesicles is impeded, and the process of oxidation is mechanically as well as chemically suppressed. The same contraction is also exerted on the vessels of the skin, driving the blood into the interior and better protected organs. Hence the reason why on leaving a warm room to enter a cold frosty air there is an immediate action of the visceral organs from pressure of blood on them, and not unfrequently a tendency to diarrhoea from temporary congestion of the digestive tract. Three factors are at work, in fact, whenever the low wave of temperature affects the animal body; abstraction of heat from the body, beyond what is natural; arrest of chemical action and of combustion; paralysis of the minute vessels exposed to the cold.

COMBINED EFFECTS.

We cannot view the extent of change in the organic life induced by the low wave of heat without seeing at once the sweep of mischief which exposure to the wave may effect. It exerts an influence on healthy life in the middle-aged man, and I know of no disease which it does not influence disastrously. Is the healthy man exhausted, it favors internal congestion; has he a weak point in the vascular system of his brain, it renders that point liable to pressure and

Page 36

rupture, with apoplexy as the sequence; is he suffering from bronchial disease, and obstruction, already, in his air passages, here is a means by which the evils are doubled; has he a feeble, worn-out heart, it is unable to bear the pressure that is put upon it; has he partial obstruction of the kidney circulation, he is threatened with complete obstruction; is he indifferently fed, he is weakened generally. It is from this extent of action that the mortality of all diseases runs up so fast when the low wave of heat rolls over the population, affecting, as we have seen, the feeblest first.

Another danger sometimes follows which is remote, but may be fatal, even to persons who are in health. It is one of the best known facts in science that when a part of the surface of the body has been exposed long to cold, the greatest risk is run in trying suddenly to warm it. The vessels become rapidly dilated, their coats relax, and extreme congestion follows. But what is true of the skin is true equally, and with more practical force, of the lungs. A man, a little below par, goes out when the wave of temperature is low, and feels oppressed, cold, weak, and miserable; the circulation through his lungs has been suppressed, and he is not duly oxidizing; he returns to a warm place, he rushes to the fire, breathes eagerly and long the heated air, and adds to the warmth by taking perchance a cup of stimulant; then he goes to bed and wakes in a few hours with what is called pneumonia, or with bronchitis, or with both diseases. What has happened? The simple physical fact of reaction under too sudden an exposure to heat after exposure to cold. The capillaries of the lungs have become engorged, and the circulation static, so that there must be reaction of heat, inflammation, before recovery can occur. Nearly all bronchial affections are induced in this manner, not always nor necessarily in the acute form, but more frequently by slow degrees, by repetition and repetition of the evil. Colds are often taken in this same way, from the exposed mucous surfaces of the nose and throat being subjected first to a chill, then to heat.

The wave of low temperature affecting a mixed population finds inevitably a certain number of persons of all ages and conditions on whom to exert its power. It catches them too often when they least expect it. An aged man, with sluggish heart, goes to bed and reclines to sleep in a temperature, say, of 50 deg. or 55 deg.. In his sleep, were it quite uninfluenced from without, his heart and his breathing would naturally decline. Gradually, as the night advances, the low wave of heat steals over the sleeper, and the air he was breathing at 55 deg. falls and falls to 40 deg., or it may be to 35 deg. or 30 deg.. What may naturally follow less than a deeper sleep? Is it not natural that the sleep so profound shall stop the laboring heart? Certainly. The great narcotic never travels without fastening on some victims in this wise, removing them, imperceptibly to themselves, into sleep ending in absolute death.

Page 37

SOME SIMPLE RULES.

The study of the physiological influence of the wave of low temperature, and of its relation to the wave of mortality, suggests a few rules, simple, and easily remembered.

1. Clothing is the first thing to attend to. To have the body, during variable weather, such as now obtains, well enveloped from head to foot in non-conducting substance is essential. Who neglects this precaution is guilty of a grievous error, and who helps the poor to clothe effectively does more for them than can readily be conceived without careful attention to the subject we have discussed.

2. In sitting-rooms and in bedrooms it is equally essential to maintain an equable temperature; a fire in a bedroom is of first value at this season. The fire sustains the external warmth, encourages ventilation, and gives health not less than comfort.

3. In going from a warm into a cold atmosphere, in breasting the wave of low temperature, no one can harm by starting forth thoroughly warm. But in returning from the cold into the warm the act should always be accomplished gradually. This important rule may readily be carried in mind by connecting it with the fact that the only safe mode of curing a frozen part is to rub it with ice, so as to restore the temperature slowly.

4. The wave of low temperature requires to be met by good, nutritious, warm food. Heat-forming foods, such as bread, sugar, butter, oatmeal porridge, and potatoes, are of special use now. It would be against science and instinct alike to omit such foods when the body requires heat.

5. It is an entire mistake to suppose that the wave of cold is neutralized in any sense by the use of alcoholics. When a glass of hot brandy and water warms the cold man, the credit belongs to the hot water, and any discredit that may follow to the brandy. So far from alcohol checking the cold in action, it goes with it, and therewith aids in arresting the motion of the heart in the living animal, because it reduces oxidation.

6. Excessive exercise of the body, and overwork either of body or of mind, should be avoided, especially during those seasons when a sudden fall of temperature is of frequent occurrence. For exhaustion, whether physical or mental, means loss of motion in the organism; and loss of motion is the same as loss of heat.

One further consideration, suggested by the subject of this paper, has reference to the bearing of the public toward the labors of the medical man in meeting the effects of the low wave of heat. The public, looking on the doctor as a sort of mystical high priest who ought to save, may often be dissatisfied with his work. Let the dissatisfied think of what is meant by saving when there is a sudden fall in the thermometer. Let them recall that it is not bronchitis as a cause of death, nor apoplexy, nor heart disease, as such, that the doctor is called

Page 38

on to meet; but an all-pervading influence which overwhelms like the sea, and against which, in the mass, individual effort stands paralyzed and helpless. When the doctor is summoned the mischief has at least commenced, and, it may be, is so far over that treatment by mere medicines sinks into secondary significance. Then he, true minister of health, candid enough to bow humbly before the great and inevitable truth, and professing no specific cure by nostrum or symbol, can only try to avert further danger by teaching elementary principles, and by making the unlearned the participators in his own learning.—*The Asclepiad.*

* * * * *

THE TREATMENT OF GLAUCOMA.

As this disease is so fatal to vision, any remedy that may be suggested to diminish the frequency of its termination in blindness cannot fail to be read of with interest. M. Nicati, in the *Revue generate de clinique et de therapeutique*, has had marked success in the treatment of glaucoma by drainage of the posterior chamber, either by sclerotomy or by sclero-iritomy, as the conditions of the individual case may require.—*N.Y. Med. Jour.*

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A TWIN SCREW LAUNCH RUN BY A COMPOUND ENGINE.

[Illustration: TWIN SCREW STEAM LAUNCH GEMINI.]

The launch shown in our illustration was built in New Westminster, British Columbia, Canada. She is 42 ft. keel and 7 ft. beam, and has 4 ft. depth of hold. She has an improved Clarke compound engine, also shown in an accompanying illustration, with a high pressure piston four inches in diameter, and a low pressure piston eight inches in diameter, the stroke being six inches, and the engine driving two twenty-six inch screws. With 130 pounds of steam, and making 275 revolutions per minute, the launch attains a speed of nine miles per hour, thus fully demonstrating the adaptability of this engine to the successful working of twin screws.

[Illustration: THE CLARKE COMPOUND TWIN-SCREW OPERATING ENGINE.]

In the Clarke engine, the exhaust pipe from the high pressure cylinder leads to the steam chest of the low pressure cylinder, while the piston in the upper cylinder is secured on a piston rod extending downward and connected with a piston operating in the lower cylinder, the exhaust pipe from the latter leading to the outside. On the piston

rod common to both cylinders is secured a crosshead pivotally connected by two pitmen with opposite crank arms on crank shafts mounted to turn in suitable bearings on the base, which also supports a frame carrying the low pressure cylinder, on top of which is a frame supporting the high pressure cylinder. The valves in the two steam chests are connected with each other by a valve rod connected at its lower end in the usual manner with the reversing link, operated from eccentrics secured on one of the crank shafts.

Page 39

The crank arms stand at angles to each other, so that the crank shafts are turned in opposite directions, and the position of the link is such that it can be readily changed by the reversing lever to simultaneously reverse the motion of the crank shafts. On the crank shafts are also formed two other crank arms pivotally connected by opposite pitmen with a slide mounted in vertical guideways, supported on a frame erected on the base, the motion of the crank shafts causing the vertical sliding motion of the slide traveling loosely in the guideways, and thus serving as a governor, as, in case one of the propellers becomes disabled, the power of the shaft carrying the disabled propeller is directly transferred to the other shaft through the crank arms, pitmen, and slide, and the other propeller is caused to do all the work. All the parts of the engine are within easy reach of the engineer, and there are so few working parts in motion that the friction is reduced to a minimum.

It is said that the plan of construction and the operation of this engine have been carefully observed by practical engineers, and that, considering the dimensions of the boat, her speed, the smallness of the power, the ease with which she passes the centers, the absence of vibration while running, and the very few working parts in motion, the engine is a notable success. She can be run at a very high velocity without injury or risk, and is designed to be very economical in cost and in weight and space. This engine has been recently patented in the United States and foreign countries by Mr. James A. Clarke, of New Westminster.

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IMPROVEMENTS IN THE CONSTRUCTION OF RIVER AND CANAL BARGES.

By M. RITTER (KNIGHT) VON SZABEL, late Austrian Naval Officer, of Vienna.

This innovation consists essentially in an arrangement by which two distinct vessels, on being revolved round their longitudinal axis to an angle of 90 deg., can be combined into one single duplex vessel, or, to put it in different words, a larger vessel is arranged so that it can be parted into two halves (called “semi-barges"), which can be used and navigated with equal facility as two distinct vessels, as if combined into one. By the combination of the two semi-barges into one duplex barge the draught of the vessel is nearly doubled, the ratio existing between the draught of a loaded semi-vessel and the equally loaded duplex vessels being 5:8 (up to 8.5)

The advantage of the invention consists:

1. In this difference of draught.

2. In the smaller width of the semi-vessel as compared with the duplex vessel.

3. In the fact that the combination and separation of the vessels can be effected, without the least disturbance of the cargo, in a minimum of time.

It facilitates the utilization, to the highest possible extent, of the varying conditions and dimensions of canal locks and rivers.

Page 40

The transition from rivers to canals, and from larger canals to smaller ones, is expedited by the possibility afforded of, on the arrival at the locks, dividing the vessel in a space of a few minutes; of passing with the semi-vessel, singly, the various smaller locks or the shallow canal, after which the two sections may be re-combined and navigated again as one vessel. The process of “folding up” the two vessels will of course take longer than that of separation.

On rivers, the channels of which are interrupted by sand banks and rapids, the same operation may be carried out, thus avoiding the expense and delay necessitated by, perhaps, repeated “lightering,” *i.e*., reduction of the cargo.

Thus, the through traffic on large rivers like the Danube, with its repeated obstacles to navigation, such as the “iron gate,” and several sand-banks known and dreaded by bargemen, would be materially facilitated, any necessity for unloading part of the cargo being obviated; moreover, such a duplex vessel composed of two semi-vessels affords the advantage of utilizing to a fuller degree the power of traction, and one large vessel will be more convenient for traffic than two smaller ones.

Further, the mode of construction of the semi-vessels—both ends of which are of a similar pattern—allows of their being navigated up and down a water channel without the necessity of turning them round; provision having also been made for the fixing of the rudder at either end, which would therefore merely require exchanging. This is of some advantage in narrow river beds and canals, and applies equally to the duplex vessel as to the single semi-vessels.

[Illustration: FIG. 1.]

[Illustration: FIG. 2.]

[Illustration: FIG. 3.]

[Illustration: FIG. 4.]

[Illustration: FIG. 5.]

Each semi-barge on its part is also constructed of two equal halves—which are, however, inseparable—and as there is no distinct stem or stern, any one of these semi-vessels will fit any other semi-vessels of the same dimensions, and can be attached to the same by means of the coupling apparatus, and the two “folded up” into one duplex vessel. This process does not present any material difficulties. The two single boats on being coupled together can be made to lean over toward each other, by filling their lateral water compartments, to such an extent that the further closing up can be easily effected by means of specially constructed windlasses. In the case of petroleum

vessels the “folding up” operation is facilitated by the circumstance that the petroleum may be made to serve the purposes of water ballast.

As regards the size and tonnage of the new vessels, this will of course depend on the local condition of the rivers and canals to be navigated. Thus a vessel destined for traffic on canals with locks of varying dimensions will have to be adapted to the dimensions of the smallest existing lock.

Page 41

Supposing the size of the latter to be such as found in the case of the Rhine-Marne or the Rhine-Rhone Canal, or on the Neckar down to Cannstadt, or in the Danube-Main Canal and some smaller canals in the Weser district, *etc*., *viz*.:

Length of lock	34.5 meters.
Width	5.2 "
Depth	1.6 to 2.0 meters.

The semi-barge may be made 32 meters in length, 4 meters in breadth and 2.5 meters total depth, and with a draught of 1.5 meters will be capable of carrying a load of 100 tons (of 1,000 kilos each). Correspondingly the duplex vessel will be able to carry 200 tons, with a minimum draught of 2.4 meters and a width of 5.4 meters, but, with a favorable height of the water level, the draught of the semi-barge may be increased to 1.65 and that of duplex vessels to 2.7 meters.

Where not limited to certain proportions by the dimensions of the locks to be passed, the vessel may in the first place be made longer; the width and height may also be increased accordingly (provided that the proportion of breadth to width is kept within the ratio 4:2.5), so that the semi-barges may be constructed for a single burden up to 300 tons, or 600 for the duplex vessel.

As regards the nature of the cargo, parcels would not be admissible in this instance, but any kind of homogeneous cargo would be suitable which would bear laying over on one side.

Thus this style of vessel would be well adapted for petroleum tank vessels, for the transport of all kinds of cereals, flour, coffee, and sugar in sacks—these latter being held in position by an arrangement of planking and boards so as to prevent any overturning of the goods on the vessels being folded up or taken apart. Similarly in the case of a cargo of loose grain or other loose produce, the same must be prevented from being upset by a kind of wooden casing.

Two semi-vessels loaded with different cargoes may be coupled together, provided that there is not too much difference between their respective draughts. Slight differences may be balanced by the water compartments being filled to a greater or smaller extent.

The peculiar position of the hatches allows of loading the semi-vessels separately as well as when coupled together.

If there is for the time being no necessity for using the vessels in their capacity of separate and duplex barges, any kind of cargo might be loaded that does not require large hatches.

The vessels, on account of their more complicated construction, will be somewhat more expensive, but wherever the advantage offered by them outweighs the extra expenditure, they can be used with success.

The innovation might be of particular importance where a new canal system is being constructed, since the latter might be subdivided into main canals and branch canals—-similarly as in the case of ordinary and narrow gauge railways—the main canal being built of a larger section and with larger locks to suit the duplex barges, while the branch canals could be planned of smaller dimensions calculated to suit the semi-barge. Thus the first cost of such a canal system would be materially reduced as compared with a canal installation of one uniform section throughout.

Page 42

Likewise in mountainous districts with rock soil it would be an important consideration whether a canal had to be blasted out of the solid rock or a tunnel cut, in dimensions suitable for a vessel of 6 or of 14 square meters section below the water line.

In this case, even in certain portions of a main canal—where rendered desirable by the rocky nature of the ground—a smaller section might be adopted, which would only be large enough for single semi-barges, so that the duplex vessel would in these instances have to be taken apart in the same way as in a branch canal.

The saving to be effected by constructing a canal on this principle, as compared with a canal of one uniform section throughout, must be considerable, and the advantages of the arrangement are apparent.

The appended figures will further illustrate the arrangement. Fig. 1 shows two separate semi-barges ready to pursue their journey independently. Fig. 2 shows two semi-barges coupled together ready to be “folded up” by means of ropes and specially constructed windlasses—their lateral water compartments having previously been filled. Fig. 3 shows the duplex vessel after the “folding up” operation just described; and Figs. 4 and 5 show the cross section of two loaded semi-barges as outlined in Figs. 2 and 3.

These Figs. 4 and 5 will also serve to illustrate the manner in which sacks and loose produce should be loaded. Fig. 4 also shows the filled water compartments, and the effect of their weight in making the boats lean toward each other.

The materials most suited for this new style of vessel will be iron and steel such as generally used in the construction of canal and river vessels.

The new ship can be moved by any motor or driving implement, nor could there technically a great difficulty be found for making the boilers move on a quadrant-like rail base in the shape of a circle segment’s quarter, or for building a double screw steamer by combining two single screw propellers.

May be a ship owner is willing to submit the innovations to an attempt, so much the more as there is running no great risk by doing so; for in case the ships should not answer the expectations, both separable as well as joinable, they can be used like single ships, without any further alteration being made, except as to the loading gaps.

The above invention is covered by United States patent No. 435,107. Any further information may be had by addressing M. v. Szabel, ix Bezirk, Beethovengasse 10, Wien, Austria.

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WELDON’S RANGE FINDER.

Page 43

Colonel Weldon has recently considerably modified and improved his ingenious range finder, and we illustrate herewith from *Engineering* the form in which it is now manufactured. It consists of a metal box, the lid of which is shown open in the engraving, and on this lid are fitted three prisms which are the essential constituents of the instrument. When the lid is closed, these, with the compass and level, also attached to the lid, lie inside the metal box, and are thus thoroughly protected. The upper prism marked 1 is a right-angled one and is mounted with the right angle outward; looking into the left-hand corner of this prism one will see in it, by double reflection, objects lying on one's right hand. Below this is a second prism with a principal angle of 88 deg. 51 min. 15 sec., and below this a third with a principal angle of 74 deg. 53 min. 15 sec.

A level and a compass are also mounted on the lid as shown. To use the instrument the observer stands so that the object the range of which is required lies on his right hand, and looking into the left-hand corner of the upper prism views it there by double reflection from the internal faces of the prism. At the same time looking through the opening shown in the lid below the prism he selects some object, which appears nearly in line with the image seen in the prism. He then shifts his position till these two images coincide, in which case lines joining him with the two objects will make right angles with each other. In Fig. 2, O is the object whose range is required, D the object seen by direct vision, and A the position of the observer. The observer now marks his position on the ground, and shifting the instrument looks into the left-hand corner of the second prism, when he again sees the image of the object, whose range is required, by double reflection, but lying now to the right of the object, D. He then retires, keeping in line with A and D, till he reaches B, when the two images again coincide; the lines joining them and the observer now make an angle of 88 deg. 51 min. 15 sec. Then in the triangle, OBA, OA = tan 88 deg. 51 min. 15 sec. X A B = 50 AB. The length AB is easily paced, and the distance OA is 50 times this length.

A longer base, and probably greater accuracy, can be obtained by using the second prism only, as indicated in Fig. 3, in which case the distance of the object is 25 times the distance BC. This second prism is, however, best adapted for predicting the range of moving objects. Three observers are required. Two of them have finders, while the other measures the distance between the two. The first two observers separate, and No. 2 takes a position such that the object is reflected to one side of observer No. 1, whom he views by direct vision. As the object continues to move, its image gets nearer and nearer No. 1, who during the whole of the time moves a little to one side or the other, so as to keep the image of the object constantly in line with No. 2. Just as the image of the object gets very near No. 1, No. 2 calls out "Ready," the distance between the two observers is taken by the third, and when the image of the object actually falls on No. 1 its distance is just 25 times the distance between them, and the guns set to this range are fired by word of command from No. 2.

Page 44

[Illustration: FIG. 2. & FIG. 3.]

By using the third prism in conjunction with the second a still longer base of one-fourth the distance of the object can be employed. The range finder can also be used as a depleidoscope for transit observations. For this purpose it is mounted on a block of wood by means of elastic band and leveled by the level on its lid, being at the same time set in the meridian of the place. The lid is opened to make an angle with the horizon equal to the latitude of the place of observation. On looking into the upper prism two images of the sun will be seen on each side of the apex of the prism, which gradually approach each other as the sun nears the meridian, and finally coincide as it passes it, the time of which being noted gives the longitude of the place.

Extensive trials of the instrument have been made both in this country and in India, which agree in showing that the average error in using the instrument is about 21/2 to 31/2 per cent.

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WHEELS LINKED WITH A BELL CRANK.

[Illustration: FIG. 1]

There are four ways in which a connecting rod is made use of in machine work. The first is in linking two wheels together that stand in the same position, but a slight distance off centers. The rod in this case has only to lead the driven wheel around by connecting it with the driver, and consequently has only to endure a pulling strain in the direction of its length. The second is when the rod is called upon to stand a pull and a push at every revolution. The third takes in the matter of the twisting strain that a rod can manage; but the fourth brings the hardest usage that a connecting rod can be called upon to endure, and that is by making a lever of the rod to get a driving action by prying on a fulcrum in the center. In Fig. 1 is seen a case of this kind taken from a machine in which a disk engine was made use of. The rod has a chance to turn about on its center from a ball and socket joint, and engages with both wheels in nicely fitted journals, and boxes set in line with the center of the socket joint, so that when one wheel turns, the rod pries the other around by using the rod as a lever and the ball joint for a fulcrum, giving a uniform leverage all the while, with no dead centers.

[Illustration: FIG. 2.]

To set this arrangement around at right angles, or where the shafts will bring the wheels together, as for bevel gears, a bent lever arm would need to be used, as shown in Fig. 2, but the bend in the connecting arms brings in another feature that must be provided, as it allows the wheels to turn either with or against each other, and leaves two places

where the bent arms will come to a dead center. What is needed here is another element that will take all the twisting strain on the rod and keep the pitch of both arms alike in every portion of a revolution. To do this

Page 45

the ball and socket joint will need to be replaced by a gambrel joint like a ship's compass, and arranging the bent driving arms as shown in Fig. 3; then the driving end of the connecting frame will move about in a true circle, producing as great a tendency to turn the driving wheel in one position as another. In this arrangement there must be at least six nicely fitted journals and their bearings, four of which will be required to take care of the forked connecting rod that joins the wheels together. Besides all this the bearings must all line up with the same center that the shafts are centered from or there will be a "pinch" somewhere in the system. It may seem at first that there must be more or less end-on movement provided for, and that the bearings should be spherical; but that it is not the case will be noticed when all the points are understood to be working from one center similar to that provided for in bevel gears.—*Boston Journal of Commerce.*

[Illustration: FIG. 3.]

* * * * *

THE DECORATIVE TREATMENT OF NATURAL FOLIAGE.[1]

[Footnote 1: Lectures before the Society of Arts, London, 1891.]

By HUGH STANNUS.

Lecture I.

Sec. 1.—THE ELEMENTS OF DECORATION.

The chief impelling Motives which have caused that treatment of objects which is now termed *Decorative*, have been:

(a) That necessitated by the Usage, which is FUNCTIONAL;

(b) That resulting from the Instinct to please the eye, which is AESTHETIC;

(c) That arising from the Desire to record or to teach, which is the DIDACTIC motive;

The AESTHETIC instinct of the early peoples was gratified by:

(a) The *forms* of their weapons or tools;

(b) The *patterns* with which they are decorated;

(c) The *imitation* of the surrounding animals, *e.g*. the Deer scratched on the horn at the British Museum.

Imitation was afterward applied to the vegetable creation; and much of what is termed Ornament was derived from that class of elements.

The ELEMENTS OF DECORATION are the material used by the Artist. They might be considered to include everything that is visible; but since Decoration is a result of the aesthetic instinct, the field is narrowed to such as are pleasing *at the first glance*. And the selection is further limited to such as are suitable to the shape and size of objects.

They may be classified according to their relative Dignity, as follows:

The Human form,
Animal forms,
Natural foliage,
Artificial objects,
Artificial foliage, and
Geometrical figures.

Sec. 2.—THE TWO KINDS OF FOLIAGE.

A Distinction is made between natural and artificial foliage. They have much in common; and consequently many have supposed that our Western artificial foliage is merely a very-much-conventionalized version of natural foliage. The supposition is correct with regard to Eastern Pattern work, but not in Western Architectural ornamentation.

Page 46

A simple generalization may make this clear. The ordinary stock foliage of the Ornamentist was evolved in connection with:

(In the West)	(In the East)
ARCHITECTURE,	TEXTILES,
as in Greece.	as in Persia.

Hence the primary Elements of decoration were derived from:

(In the West)	(In the East)
GEOMETRICAL LINES,	NATURAL FLOWERS and LEAVES,
e.g. the meander, spiral, *etc.*	*e.g.* the pine, pomegranate, *etc.*

Further, it may be observed that the Method of treating these Elements has been different:

(In the West)	(In the East)
The Geometrical lines were enriched by the introduction of the details of Natural vegetation; thus becoming gradually more *naturalesque*.	The natural foliage was codified by the introduction of Geometrical arrangement; thus becoming gradually more *artificial*.

An APPROXIMATION between the two treatments, sometimes appears; but the two kinds—Artificial, and Natural—are essentially different in origin; and should be kept distinct in their application.

This approximation may be shown, in a tabular arrangement, thus:

GEOMETRY.....	.....NATURE
The patterns are merely portions of circles.	The plants are copied as straight lines, dots, and accurately as possible.
The lines become stems. The plant is applied without repetition.	
Leaves are added to the	Repetition is used with the

stems. plants.

Serration is added to the leaf-edge. Weaving economy induces symmetry.

Similarity of serrated Symmetry induces Geometrical leaf-edge to the Akanthos Severity, and the Omission plant, is observed; of all details of the Imitation becomes more original plant which are not direct; and this artificial easily worked in connection foliage becomes termed with geometrical “Acanthus.” arrangement.Flowers generally circular The Flowers and Leaves in mass-shape, are added (*only*) survive; the growth at the ends of the spiral of the stems is forgotten; stems. and tradition does the rest.

Sec. 3.—APPLICATION OF THE TWO KINDS.

Each of these two kinds of foliage has its own proper use. Artificial foliage is appropriate to the enrichment of Architecture; and Natural foliage to those objects which are not architectural, but are termed “movables,” including under this term, Furniture, and more especially Hangings and other applications of the Textile art.

Page 47

This may be seen on comparing the two columns below, of which the L.H. one refers to Architecture, and the R.H. one to Natural foliage.

(Architecture) (Natural foliage)

RULES:

Governed by severe rules of Repetition, Axiality, Symmetry, *etc*., which are apparent to the passer-by. Artificial foliage, being regular in its structure, is more appropriate than the (apparently) irregular growth of Natural foliage.

Exhibits *apparent* playful Freedom. There *are* which are apparent to are detected by the scientific Hence Botanist; but these are not seen by the casual observer.

CHARACTERISTICS:

Rigidity and Stability. Elasticity and Tremulousness in every breeze.

LINES OF COMPOSITION:

Geometrical lines. The geometrical lines and spirals of Artificial foliage demand an unmoving surface for proper view.

In determinate curves, which are very subtile, and varied, and therefore suitable to a hanging and swaying material.

The curves of Nature They would generally be spoiled if not on a plane surface.

are not spoiled when on a folded material.

DISTRIBUTION:

Symmetrical. The symmetry of artificial foliage is appropriate to that of Architecture.

Balanced. The growth of natural foliage is generally symmetrical; but this is not apparent.

BEAUTY:

Depends on *form*, with color as a secondary adjunct.

More appropriate to objects which depend on *color* for

their principal charm.

There have been waves of the desire to introduce Natural foliage into Architecture (e.g. in the “Decorated period” of Gothic architecture); but the Artificial elements have always proved too strong, and the two have never mixed. In Architecture, everything has three dimensions; and the artificial foliage is carved with leaves, *etc*., of a suitable thickness: in Natural foliage the tenuity of leaves, *etc*., is such that it cannot be reproduced. Even in the architraves round the glorious doors of Florence the natural foliage is not always a success; and where Ghiberti has stopped short in the ductile bronze, it is not probable that the modern carver will succeed in stone. It may therefore be suggested that the close imitation of Natural foliage should be confined to objects of *two* dimensions, *i.e*., to plane surfaces and figured materials.

Page 48

This selection of the Elements of Decoration, according to their association, is analogous to the selection made use of by the Poet, from the words and ideas, which are his Materials. It will be observed that, as on a Classic or Heroic subject, the choice is of learned words and classical ideas, and on a Domestic or Pastoral one, simple words and homely similes are used—so, in conjunction with the severe forms of Architecture, the formal character of artificial foliage is suitable; and for decorating Textiles and other movable Accessories, the Natural foliage, with which the earth is clothed and beautified, is appropriate.

ENRICHMENT OF SURFACE may be beautiful for one reason; IMITATION OF NATURE is beautiful for another. When imitations of natural foliage are introduced decoratively on a surface, then may it be twice beautiful—first, in the *principles* according to which the distribution is arranged; and secondly, because of the *elements* which are worked in being beautiful in themselves. Geometrical elements might be so used as to serve the first end, but can never fulfill the second: Storiation fulfills the second; but its increase of interest absorbs the first.

This course of Lectures is intended to treat of Natural foliage, leaving Artificial foliage to be dealt with at another opportunity. It is not Historical. The History of the Decorative treatment of Natural foliage, showing its evolution in the past, is a large and interesting theme; but, unless this were accompanied by critical remarks based on given principles, the method might be barren of results. Tradition is not to be undervalued; but the student should be led to Tradition through Principles.

It is further intended more especially to apply to the aesthetic use. When natural foliage is used AEsthetically (i.e., decoratively), then the Shape of the surface should govern the Mass shape of the foliage, and there should be Parallelism between them (see Sec. 29). When used Didactically (i.e., symbolically), then the foliage may be treated more freely.

Sec. 4.—THE FOUR TREATMENTS.

There are, broadly speaking, four methods of treating Natural foliage. These may be arranged in a Chart, according to their relation to the two poles of Art and Science; from Realism (which is all Art and no Science) to the “Botanical Analysis” method (in which is a little Science but no Art), thus:

The first two of these methods are Artistic and legitimate: the others are inartistic and misleading. Before treating of the artistic methods it will be well to clear the ground by dismissing the others.

ART POLE.....SCIENCE POLE

Realism (See Sec. 10).	Conventionalism (See Sec. 14).	Disguised Artificialism (See Sec. 6).	Botanical Analysis (See Sec. 5).

Sec. 5.—THE BOTANICAL ANALYSIS TREATMENT.

Page 49

In this method the student was taught (i) to draw each plant with the Stem *straightened out*, the Leaves *flattened out*, and the Flowers represented as in *side elevation* or *plan*. (ii) The Flowers were further *pulled in pieces*, and the Petals were *flattened out* in a manner similar to the Entomologists' practice of displaying their "specimens" scientifically. Often, also (iii) the Stems and Buds were *cut through*; and "patterns" were made with the Sections.

With regard to the first of these practices (i): it should be observed that much of the beauty of appearance of natural foliage results from the variety of view, the subtile curvature, and the foreshortening, as seen in perspective; and that to sacrifice all these for the sake of a *diagram* would be a wasted opportunity.

With regard to the other practices (ii) and (iii): it is obvious that these statements of the facts of the plant are useful as a part of the Science of Botany; but can no more be considered as making Decoration than Anatomical diagrams can be looked upon as Pictures. Some knowledge of external Botany is useful to a Pattern artist as some knowledge of external Anatomy is useful to the Pictorial artist. In each of these cases, the Science, which discovers and records facts, is subservient to its sister, Art, which uses the facts to interpret appearances; and, when scientific diagrams are put forth as Art, the Science is in its wrong place: it has then been treated as if it were the Building instead of being only the Scaffolding; and the results of such attempts cannot be considered as complete or final.

Examples of this method are given in Figs. 1 and 2. It was officially encouraged about twenty-five years ago; and books like "Plants, their Natural Growth and Ornamental Treatment," and "Suggestions in Floral Design," both by F. Edward Hulme, F.L.S., *etc*., show it at its best.

[Illustration: FIG. 1.]

In criticising this method, there is no desire to cast any slight upon those who were responsible for it. They were groping in the dark, and did the best they knew, according to their lights. But Japanese work was not known at that time, and, but for that, the Pattern artist of to-day might still be occupied in pinning leaves and flowers against the wall. It was, moreover, a protest against the Cabbage Rose on the Hearth rug, that some may still remember with shuddering.

[Illustration: FIG. 2.]

Sec. 6.—THE DISGUISED ARTIFICIALITY TREATMENT.

In this method the student was taught to sketch out what he considered to be good Curves and Spirals; and then (i) to bend the selected plant so that its stem might

coincide with them, regardless of its own proper natural growth; or (ii) to deck out the first drawn spirals with the leaves and flowers of the selected plant.

Page 50

With regard to the first of these practices: it is much more foolish than the Analysis method; and is little short of blasphemy against the Great Designer. He has determined how each plant shall grow: how, within limits of cultivation, its stems and branches shall separate, each to seek its own share of air and sunshine; how its leaves shall stand erect or droop, each according to its function; and always in perfect beauty. And further: how each family of plants shall have its own method of branching; which is as much a part of its character and often of its beauty as are the Flowers and Leaves.

The second practice, which generally produces a result similar to the first, is quite as unthinking. It is more often practiced; and is responsible for many of the labored and uninteresting designs which are common. If the Pattern-artist deck-out the old worn-out and common place spirals with leaves and flowers borrowed from Nature—the result is like the “voice of Jacob and the hands of Esau;” it is merely a Disguise of Artificiality.

An example of this method is given in Fig. 3. It was generally practiced in Germany; and books like “Das Vegetabile Ornamente,” by K. Krumbholz, show it at its best.

[Illustration: FIG. 3.]

If this treatment were universally followed—there would soon be an end to design with natural foliage. The spectator might observe one border which appeared to be a Rose, another a Tulip, the third a Thistle, and the fourth a Fuchsia; and, on examination, discover that these were not Rose, Tulip, Thistle, and Fuchsia; but merely that very artificial old friend—the Spiral-scroll—*in disguise*.

An apologist for this method remarks:—” ... In such matters as the ramification of plants, ... nature is always making angles and elbows [*sic*] which we are obliged, in decorative treatment, to change into curves for our purpose;...”. This opinion needs only to be applied to animals in order to exhibit its absurdity; and with regard to plants, it will be seen that this tampering has not even the poor merit of success.

Sec. 7.—NOTE ON SYMMETRY.

A desire for Symmetry often accompanies these two treatments. This is a quality to be avoided whenever possible in Natural foliage design. The so-called “Turn-over patterns” are an economy in Weaving-design, but the economy is of the wrong kind. An artist should spend his thought to spare material or cost in working. When he spares his *thought*—making the least amount of thought cover the greatest amount of surface—then is his work worth to the world just what it has cost him, *i.e*., very little.

So injurious is the influence of Symmetry in Natural foliage design, that it might almost be a test question—“Is the design symmetrical?” When the exigencies of Machine-reproduction necessitate this with Natural foliage—it is a hardship which the Artist regretfully accepts, and no one would willingly make a design for Hand-reproduction

which was symmetrical; rather would he spend himself to insure the worthier result which ensues from Balance.

Page 51

An example of Symmetry is given in Fig. 4; and of Balance in Fig. 5. Each panel contains two classes of Elements:—Natural foliage (i.e., two branches of the Bay tree), and an Artificial object (i.e., a Ribbon which ties them). The lower Element (i.e., the Ribbon) is treated symmetrically in both panels: the higher Element (i.e., the Branches) are *symmetrical* in the former panel, and *balanced* in the latter. This latter treatment, will be seen to be not only the more interesting, but the more like the infinite variety of Nature; while the former is a wasted opportunity, and contrary to Nature.

[Illustration: FIG. 4.]

The Student will observe by experience that the mind soon tires of Artificiality, both in Curvature and in Symmetry; the lines of Nature have a pleasant freshness and inexhaustible variety; and the *Natural* method of treating Nature is not only the most true, but also the most beautiful.

[Illustration: FIG. 5.]

Sec. 8.—REALISM AND CONVENTIONALISM: DEFINITIONS.

REALISM—the result of *Realistic* treatment, *i.e*., the attempt to render the reproduction as like the reality as is possible, even to the verge of deception—is the aim of the Pictorial-Artist. In Pictures the surface appears to have been annihilated, and the spectator beholds the scene as if there were a hole through the wall. It is not the highest, and should not be the only aim in Art; but it has always been sought for and admired. It requires perfect conditions, of materials and tools; *i.e*., *complete Technical appliances*.

CONVENTIONALISM—the result of *incomplete Technical appliances*, and the attempt to render so much of the Beauty of the original as is possible, with due regard to their capabilities—is the aim of the Decorative-Artist. It is not the highest aim; though a necessary curb in Decorative-Art, both for the technical reason, and also as a result of the Position or Function of the object.

It will thus be seen that the two words, when used with regard to foliage of any kind, refer to the *Method of representing it*, and not to its Kind or its manner of Growth.

Sec. 9.—SCALES FROM REALISM TO CONVENTIONALISM.

These two methods, when applied absolutely, form the two extremes:—The most complete REALISM being at one end, and the most limited CONVENTIONALISM at the other. There are scales of gradual reduction between them, which may be shown on two charts:

(i) Reduction in the NUMBER OF PARTS which preserve their Realistic rendering.

(ii) Reduction in the DEGREE OF REALISM through all parts.

(i) According to the number of the features or parts of the design which are treated with less than realism. Thus there might be a panel representing a Window-opening with an architectural framing, with a Flower-vase on the sill, and a Landscape-background. The first part to be reduced in realistic rendering would be the Background, the second would be the Framing, leaving the third, the Flower-vase, as the survival. This is a Scale of reduction in *Number of Parts*.

Page 52

It may be shown, in tabular arrangement, thus:—

REALISM.....CONV
ENTIONALISM.

COMPLETE PICTORIAL REALISM, in which all parts are realistically represented (see Sec. 10).

SEMI-PICTORIAL REALISM, in which the Back-ground is reduced to a flat-tint, while all the remaining parts are realistically represented (see Sec. 11).

DECORATIVE REALISM, in which the chief Feature (*only*) is realistically represented, and all the other parts are reduced to conventional renderings (see Sec. 12).

COMPLETE CONVENTIONALISM, in which all parts are reduced to conventional renderings (see Conventionalism).

Inasmuch as there is some realistic part remaining in each of the first three methods—-these are classified under the heading of REALISM.

(ii) According to the Degree in which color, gradation, or shading, is sacrificed, in consequence of the limited Means at the disposal of the Artist; resulting in the gradual departure from Realism to the most severe Conventionalism. The reduction is applied to all parts of the work. This is a scale of reduction in *Degree*. There are two Varieties in each degree; and they are marked with italic letters.

It may be shown, in tabular arrangement, thus:—

REALISM.....CON
VENTIONALISM.

COMPLETE REALISM, in which all parts are represented, in proper colors, and perfect gradation, with correct light and shade (see Sec. 10).

FIRST DEGREE OF CONVENTIONALISM, in which all parts are represented: (a) By a reduced number of Pigments, the other qualities remaining; (b) By reduction in gradation and shading to Flat-tints of several pigments (see Sec. 15).SECOND DEGREE OF CONVENTIONALISM, in which all parts are represented: (c) By a

reduction to Monochrome of color, with Gradation (*only*) remaining; (d) By reduction to Monochrome of White and Black, with Gradation (*only*) remaining (see Sec. 16).THIRD DEGREE OF CONVENTIONALISM, in which all parts are represented: (e) By reduction to a Flat-tint of one pigment on a ground of another; (f) By reduction to a Flat-tint of White on Black, or *vice versa* (see Sec. 17).

> ULTIMATE CONVENTIONALISM, in which all parts are represented; (g) By reduction to Outline of several pigments; (h) Reduction to Outline of one pigment (see Sec.18).

Inasmuch as Realism ceases so soon as any reduction in the three qualities (of color, gradation, and shadow) is introduced; and the treatment becomes more Conventional in each method after the first—these are classified under the heading of CONVENTIONALISM.

[There is an analogous scale of reduction in Form, from the Complete-relief of an isolated Statue to the Flatness of a Floor-plate; but this does not belong to the present subject.]

Page 53

* * * * *

THE CYCLOSTAT.

The various processes commonly employed for the observation of bodies in motion (intermittent light or vision) greatly fatigue the observer, and, as a general thing, give only images, that are difficult to examine. We are going to show how Prof. Marc Thury, upon making researches in a new direction, has succeeded in constructing an apparatus that permits of the continuous observation of a body having a rapid rotary motion. The principle of the method is of extreme simplicity.

[Illustration: FIGS. 1, 2, AND 3.—DIAGRAMS EXPLANATORY OF THE PRINCIPLE OF THE CYCLOSTAT.]

Let us consider (Fig. 1) a mirror, A B, reflecting an object, C D, and revolving around it: when the mirror will have made a half revolution, the image, C' D', of the object will have made an entire one. The figure represents three successive positions of the mirror, distant by an eighth of a revolution. The structure of the image shows that it has made a quarter revolution in an opposite direction in each of its positions. But if (Fig. 2) the body itself has revolved in the same direction with an angular velocity double that of the mirror, its image will have described a circle in remaining constantly parallel with itself. The image will be just as insensible as the object itself; but it is very easy to bring it back to a state of rest.

Let us suppose (Fig. 3a) the observer placed at O, the revolving object at T, the axis of rotation being this time the line O F. Let us place a mirror at A B and cause it to revolve around the same axis; but, instead of looking at the image directly in the mirror, let us receive it, before and after its reflection upon A B, upon two mirrors, C D and D E, inclined 30 deg. upon the axis of rotation of the system; the image, instead of being observed directly in the mirror, A B, will always be seen in the axis, O F, and will consequently appear immovable.

The same result may be obtained (Fig. 3b) with a rectangular isosceles prism whose face, A B, serves as a mirror, while the faces, A C and B D, break the ray—the first deflecting it from the axis to throw it on the mirror, and the second throwing it back to the axis of rotation, which is at the same time the line of direction of the sight.

The principle of the instrument, then, consists in causing the revolution, around the axis of rotation of the object to be observed, of a mirror parallel with such axis, and in observing it in the axis itself after sending the image to it by two reflections or two refractions. In reality, the entire instrument is contained in the small prism above, properly mounted upon a wheel that may be revolved at will; and, in this form, it may serve, for example, to determine the rotary velocity of an inaccessible axis. For this it

will suffice to modify its velocity until the axis appears to be at rest, and to apply the revolution counter to the wheel upon which the prism is mounted, or to another wheel controlling the mechanism.

Page 54

But Mr. Thury has constructed a completer apparatus, the *cyclostat* (Fig. 4), which, opposite the prism, has a second plate whose actuating wheel is mounted upon the same axis as the first, the gearing being so calculated that the prism shall revolve with twice less velocity than the second plate. This latter, observed through the prism, will be always seen at rest, and be able to serve as a support for the object that it is desired to examine.

[Illustration: FIG. 4.—THE CYCLOSTAT.

1. General view of the apparatus. 2. Section of the ocular, O.]

The applications are multitudinous. In the first place, in certain difficult cases, it may serve for the observation of a swinging thermometer, which is then read during its motion. Then it may be employed for the continuous observation of a body submitted to centrifugal force. Apropos of this, we desire to add a few words. Most of the forces at our disposal, applied to a body, are transmitted from molecule to molecule, and produce tension, crushing, *etc*. Gravity and magnetic attraction form an exception; their point of application is found in all the molecules of the body, and they produce pressures and slidings of a peculiar kind. But these forces are of a very limited magnitude; but it might nevertheless be of great interest to amplify them in a strong measure. Let us, for example, suppose that a magician has found a means of increasing the intensity of gravity tenfold in his laboratory. All the conditions of life would be modified to the extent of being unrecognizable. A living being borne in this space would remain small and squat. All objects would be stocky and be spread out in width or else be shattered. Viscid or semi-solid bodies, such as pitch, would rapidly spread out and take on a surface as plane and smooth as water under the conditions of gravity upon the earth. On still further increasing the gravity, we would see the soft metals behaving in the same way, and lead, copper and silver would in turn flow away. These metals, in fact, are perfectly moulded under a strong pressure, just like liquids, through the simple effect of the attraction of the earth applied to all their molecules. Upon causing an adequate attractive force to act upon the molecules of metals they will be placed under conditions analogous to those to which they are submitted in strong presses or in the mills that serve for coining money. The sole difference consists in the fact that the action of gravity is infinitely more regular, and purer, from a physical standpoint, than that of the press or coining mill. Through very simple considerations, we thus reach the principle which was enunciated, we believe, by the illustrious Stokes, that our idea of solid and liquid bodies is a necessary consequence of the intensity of gravity upon the earth. Upon a larger or smaller planet, a certain number of solid bodies would pass to a liquid state, or inversely. Let us return to the cyclostat. In default of

Page 55

gravity, centrifugal force gives us a means of realizing certain conditions that we would find in the laboratory of our magician. The cyclostat permits us to observe what is going on in that laboratory without submitting ourselves to forces that might cause us great annoyance. We have hitherto been content to put poor frogs therein and study upon them the effect of the central anaemia and peripheral congestion produced on their organism by the unrestrained motion of the liquids carried along by centrifugal force. The results, it seems, have proved very curious.—*La Nature*.

* * * * *

MERCURY WEIGHING MACHINE.

We illustrate herewith a novel type of weighing machine. Hitherto the weighing machines in common use have either been designed with some kind of steelyard apparatus, upon which weights could be moved to different distances from a fixed fulcrum, or springs have been so applied as to be compressed to different degrees by different weights put upon the scale pan, or table, of the machine. In other instances more complicated mechanism is used, and various movable counterpoises are usually required in order to balance the moving parts of the machine.

[Illustration]

The type of machine which we now illustrate has been recently brought out by Mr. G.E. Rutter, and the system has given very satisfactory results with platform weighing machines. The engraving illustrates a form of balance which may be applied to strength testing machines, or for any work where an apparatus of the type of a Salter's balance would be of use. It is simple in construction, and consists of a tube A closed at the bottom and forming a reservoir for mercury. The body which it is required to weigh is hung upon the hook B carried by the crossbar C, which is connected by rigid rods to the upper part of the tube, and by means of the internal rods D is attached to the cross head E, which works freely inside the tube A. The top part of the tube is, as will be clearly understood from the illustration, cut away to allow of the descent of the rods. To the cross head E is attached the piston F, which may be made of wood or of a hollow metal tube closed at the end, or other suitable material. It will be easily understood that when a weight is hung upon the hook B, the piston F is caused to descend into the mercury which rises in the annular space between the piston and the tube. The weight of the volume of displaced mercury is proportional to the weight of the body hung upon the hook, and the buoyancy of the piston in the mercury forms the upward force which balances the downward pull of gravity. When the apparatus is at rest the piston F descends into the mercury to such a distance as will balance the weight of the rods,

hook, and piston itself. If, now, the cross bar G, provided with a pointer H, be fixed to the rods, it should at that time register zero, upon the scale

Page 56

J fixed to the outside of the tube, and as the descent of the piston into the mercury is directly proportional to the weight of the body attached to the hook B, the divisions of the scale will all be equal. It will thus be seen that the apparatus is extremely simple in theory, and it only remains to construct it in such a form that the mercury may not easily be spilt in moving the instrument from place to place. This is effected by causing the cross head E to fill the tube while working freely therein, and a small valve is arranged to allow for the passage of air. The cross bar G can be regulated upon the rods by means of set screws.—*Industries.*

* * * * *

REEFING SAILS FROM THE DECK.

While this method may be applied to topsails and top-gallant-sails, I especially apply it to courses, which, being so difficult to reef the old way, may by this method be reefed from the deck in a few minutes.

After several years of trial by myself and others, on voyages around Cape Horn under all circumstances of weather, of sleet and snow, this method has always given the utmost satisfaction.

[Illustration: REEFING SAILS FROM THE DECK. Front View. Rear View.]

The average time required for reefing and setting was noted for five years, being seven and one-half minutes.

This trial was made on a mainsail, the yard being seventy-one feet long, and reefyard sixty-six feet long, eleven inches diameter at center and nine at yard-arms.

By reference to the drawing it will be seen that it is not necessary to have clewgarnets or buntlines in reefing. The operation is performed by easing of the sheet and hauling the lee reef-tackle first, also the midship reef tackle.

When the yardarm of the reefspar is up at the lee side, the sail cannot sag to leeward when the tack is eased away. Now haul the weather reef-tackle likewise midship, snug up to the yard, belay all down the tack, and sheet aft.

As all the reef-tackles lead to the slings of the yard, there is no impediment in swinging the yard when the reef-tackles are taut and belayed.

The slack sail will not chafe, as it remains quiet, but if so desired may be stopped up at leisure with only a few hands with stops provided for that purpose.

In case of a sudden squall the sail may be hauled up the usual way. The buntlines will draw the part of the sail below the reef well up on the part above the reefyard, and remain becalmed, while the weight of the reefspar will prevent any slatting or danger of losing the sail any more than any other sail clewed up.

In case there is steam power at hand, all three reef-tackles may be hauled simultaneously, easing sheet and tack sufficiently to let the wind out of the sail without shaking.

There are other advantages gained by this method; while its essentials are positive, quick reefing from the deck in all weathers, it is also better reefed than by the old method. For by this new method the sail is not strained or torn, and the sail will wear longer, not being subject to such straining.

Page 57

It may be carried longer, as the spar supports the sail like a band, especially an old sail.

This method does not interfere with the use of the so called midship-tack, but change of putting on bands, from the leech of the sail at the reef to the center tack would be necessary.

The weight of the spar may be considered by some as objectionable, (an old argument against double-topsail yards). The spar used for the reef may be about one-half the diameter of the yard on which it is to be used.

Such critics do not consider that a crew of men aloft on the yard are several times heavier than such a spar.

L.K. MORSE.

Rockport, Me., Oct. 28, 1891.

* * * * *

A NEW PROCESS FOR THE BLEACHING OF JUTE.

By Messrs. LEYKAM and TOSEFOTHAL.

Jute is well known as a very cheap fiber, and its employment in textile industry is consequently both extensive and always increasing. Accompanying this increase is a corresponding one in the amount of old waste jute, which can be employed for the manufacture of paper.

Up to the present time, only very little use has been made of jute for the manufacture of thread and the finer fabrics, because the difficulty of bleaching the fiber satisfactorily has proved a very serious hindrance to its improvement by chemical means. All the methods hitherto proposed for bleaching jute are so costly that they can scarcely be made to pay; and, moreover, in many cases, the jute is scarcely bleached, and loses considerably in firmness and weight, owing to the large quantities of bleaching agents which have to be applied.

In consequence of this difficulty, the enormous quantities of jute scraps, which are always available, are utilized in paper making almost entirely for the production of ordinary wrapping paper, which is, at the best, of medium quality. In the well known work of Hoffmann and Muller, the authors refer to the great difficulty of bleaching jute, and therefore recommend that it be not used for making white papers.

Messrs. Leykam and Tosefothal have succeeded in bleaching it, and rendering the fiber perfectly white, by a new process, simple and cheap (which we describe below), so that their method can be very advantageously employed in the paper industry.

The jute fiber only loses very little of its original firmness and weight; but, on the other hand, gains largely in pliability and elasticity, so that the paper made from it is of great strength, and not only resists tearing, but especially crumpling and breaking.

The jute may be submitted to the process in any form whatever, either crude, in scraps, or as thread or tissue.

Page 58

The material to be bleached is first treated with gaseous chlorine or chlorine water, in order to attack the jute pigment, which is very difficult to bleach, until it takes an orange shade. After having removed the acids, *etc*., formed by this treatment, the jute is placed in a weak alkaline bath, cold or hot, of caustic soda, caustic potash, caustic ammonia, quicklime, sodium or potassium carbonate, *etc*., or a mixture of several of these substances, which converts the greatest part of the jute pigment, already altered by the chlorine, into a form easily soluble in water, so that the pigment can be readily removed by a washing with water. After this washing the jute can be bleached as easily as any other vegetable fiber in the ordinary manner, by means of bleaching powder, *etc*., and an excellent fibrous material is obtained, which can be made use of with advantage in the textile and paper industries.

The application of the process may be illustrated by an example:

One hundred kilos. of waste jute scraps are first of all treated in the manner usually employed in the paper industry; 15 per cent. of quicklime is added, and they are treated for 10 hours at a pressure of 11/2 atmospheres. The scraps are then freed from water by means of a hydro-extractor, or a press, and finally saturated with chlorine in a gas chamber for 24 hours or less, according to the requirements of the case. Every 100 kilos. of jute requires 75 kilos. of hydrochloric acid (20 deg. B.) and 20 kilos. of manganese peroxide (78-80 per cent.).

The jute then takes an orange color, and is subsequently washed in a tank, a kilo. of caustic soda being added per 100 kilos. of jute; this amount of alkali is sufficient to dissolve the pigment, which colors the water flowing from the washer a deep brown. After washing, the jute can be completely bleached by the use of 5-7 kilos. of bleaching powder per 100 kilos. of jute.—*Mon. de la Teinture*.

* * * * *

THE INDEPENDENT—STORAGE OR PRIMARY BATTERY—SYSTEM OF ELECTRIC MOTIVE POWER.[1]

[Footnote 1: Abstract of a paper read before the American Streel Railway Association, Oct. 23, 1891.]

By KNIGHT NEFTEL.

Owing to a variety of causes, the system which was assigned to me at the last convention to report on has made less material progress in a commercial way than its competitors.

PRIMARY BATTERIES.

So far, primary batteries have been applied only to the operation of the smallest stationary motors. Their application in the near future to traction may, I think, be entirely disregarded. Were it not a purely technical matter, it might be easily demonstrated, with our knowledge of electro-chemistry, that such an arrangement as an electric primary battery driving a car is an impossibility.

Page 59

In view of the claims of certain inventors, I regret to be obliged to make so absolute a statement; but the results so far have produced nothing of value.

SECONDARY BATTERIES.

The application of secondary or storage batteries to electrical traction has been accomplished in a number of cities, with a varying amount of success. Roads equipped by batteries have now been sufficiently long in operation to allow us to draw some conclusions as to the practical results obtained and what is possible in the near future. The advantages which have been demonstrated on Madison Avenue, in New York; Dubuque, Iowa; Washington, D.C., and elsewhere, may be summarized as follows:

First. The independent feature of the system. The cars independent of each other, and free from drawbacks of broken trolley wires; temporary stoppages at the power station; the grounding of one motor affecting other motors, and sudden and severe strains upon the machinery at the power station, such as frequently occur in direct systems; the absence of all street structures and repairs to the same, and the loss by grounds and leakages, are also very considerable advantages, both as to economy and satisfactory operation.

Second. The comparatively small space required for the power station. Each car being provided with two or more sets of batteries, the same can be charged at a uniform rate without undue strain on the machinery of the power station, and as it can be done more rapidly than the discharge required for the operation of the motors, a less amount of general machinery is necessary for a given amount of work.

Another and important advantage of the system is the low pressure of the current used to supply the motors, and the consequent increased durability of the motor, and practically absolute safety to life from electrical shock.

It has been demonstrated also that the cars can be easily handled in the street; run at any desired speed, and reversed with far more safety to the armature of the motor than in the direct system. The increased weight requires simply more brake leverage.

The modern battery, improved in many of its details during the last year, is still an unknown quantity as to durability. There is the same doubt concerning this as there was at the time incandescent lamps were first introduced. At that time some phenomenal records were made by lamps grouped with other lamps.

Similarly, some plates appeared to be almost indestructible, while others, made practically in the same manner, deteriorate within a very short time. It is, consequently, very difficult to exactly and fairly place a limit on the life of the positive plates as yet. Speaking simply from observation of a large number of plates of various kinds, I am

inclined to put the limit at about eight months; though it is claimed by some of the more prominent manufacturers—and undoubtedly it is true in special cases—that entire elements have lasted ten months, and even longer.

Page 60

It must be remembered, however, that the jolting and handling to which these batteries are subjected, in traction work, increases the tendency to disintegrate, buckle and short circuit, and that the record for durability for this application can never be the same as for stationary work. A serious inconvenience to the use of batteries in traction work is the necessary presence of the liquid in the jars. This causes the whole equipment to be somewhat cumbersome, and unless arranged with great care, and with a variety of devices lately designed, a source of considerable annoyance.

The connections between the plates, which formerly gave so much trouble by breaking off, have been perfected so as to prevent this difficulty, and the shape of the jars has been designed to prevent the spilling of the acid while the car is running. The car seats are now practically hermetically sealed, so that the escaping gases are not offensive to the passengers.

The handling of the batteries is an exceedingly important consideration. Many devices have been invented to render this easy and cheap. I have witnessed the changing of batteries in a car, one set being taken out and a charged set replaced by four men in the short space of three minutes. This is accomplished by electrical elevators, which move the batteries opposite the car, and upon the platforms of which the discharged elements are again charged.

The general conclusions which the year's experience and progress have afforded us an opportunity to make may be summarized as follows:

Storage battery cars are as yet applicable only to those roads which are practically level; where the direct system cannot be used, and where cable traction cannot be used; and applicable to those roads only at about the same cost as horse traction.

I feel justified in making this statement in view of the guarantees which some of the more prominent manufacturers of batteries are willing to enter into, and which practically insure the customer against loss due to the deterioration of plates: leaving the question of the responsibility of the company the only one for him to look into.

* * * * *

ON THE ELIMINATION OF SULPHUR FROM PIG IRON. [1]

[Footnote 1: Paper read before the Iron and Steel Institute.]

By J. MASSENEZ, Hoerde.

If in the acid and the basic Bessemer processes the molten pig iron is taken direct to the converter from the blast furnace, there is the disadvantage that the running of the individual blast furnaces can hardly ever be kept so uniform as it is desirable should be the case in order to secure regularity in the converter charges. In the manufacture of Bessemer steel the variable proportions of silicon and of carbon here come chiefly under consideration, while in the basic process it is chiefly the varying proportions

Page 61

of silicon and of sulphur; and in cases where either ores containing variable percentages of phosphorus, or puddle slags, are treated, the varying proportion of phosphorus has also to be considered. This disadvantage of the irregular composition of the individual blast furnace charges is obviated in a simple and effective manner by W.R. Jones's mixing process. In this as much pig iron from the various blast furnaces of a works as is sufficient for a large number of Bessemer charges, say from seven to twelve charges, or, in other words, from 70 to 120 tons of pig iron, is placed in a mixing vessel. Only a portion of pig iron placed in the mixer is taken for further treatment for steel, while new supplies of pig iron are brought from the blast furnace. In this way homogeneity sufficient for practical purposes is obtained.

In the treatment of phosphoric pig iron, which is employed in the production of basic steel, it is, however, not sufficient merely to conduct the molten pig iron in large quantities to the converter in a mixed condition, but the problem here is to render the proportion of sulphur also independent of the blast furnace process to such an extent that the proportion of sulphur in the finished steel is so low that the quality of the steel is in no way influenced by it. The question of desulphurization has, especially of late years, become of the utmost importance, at any rate for the iron industry of the Continent. By the great strike of 1889, the German colliers have succeeded in greatly improving their wages; and with this increase in wages not only is there a distinct diminution in the amount of coal wrought, but, unfortunately, the coal produced since then is raised in a much less pure condition than was formerly the case. Consequently the proportion of sulphur in the coke has considerably increased. Whereas formerly this proportion did not exceed one per cent., it has now in many cases risen to 18 per cent.; so that an unpleasant ratio exists between the wages of the workmen and the amount of sulphur in the coal raised. It is therefore not remarkable that, even when ores fairly free from sulphur are treated, it easily happens that a sulphureted pig iron is obtained.

In order to effect satisfactory desulphurization, attention has been bestowed on the fact that iron sulphide is converted by manganese into manganese sulphide and iron. If sulphureted pig iron, poor in manganese, is added in a fluid condition to manganiferous molten pig iron, poor in sulphur, the metal is desulphurized, and a manganese sulphide slag is formed. It may be urged that it does not seem necessary to effect the desulphurization by means of the reaction of the manganese and iron sulphide outside of the blast furnace, as it is possible, by suitably directing the blast furnace, by the employment of manganiferous ores or highly basic slag, so to desulphurize the iron in the blast furnace itself that it would be unnecessary further to lower the percentage of sulphur. Every

Page 62

blast furnace manager, however, will have observed that, even with every precaution in the blast furnace practice, pig iron will often be obtained with so high a percentage of sulphur as to render it useless for the Bessemer acid or basic processes. If the desulphurization in the blast furnace is carried sufficiently far, it is always necessary to work the furnace hot, and thus to obtain hotter iron than is desirable for further treatment in the converter. On the other hand, the method of further desulphurization outside the blast furnace, described in this paper, presents the double advantage that part of the blast furnace can be kept cooler, and thus lime and coke be saved, and that there is a certainty that no red-short charges are obtained in the treatment in the converter, while the pig iron passes to the converter at a suitable temperature.

[Illustration: FIGS. 1 through 5]

A further advantage presented by the direct process described in this paper is that the Bessemer works is independent of the time at which the individual blast furnaces are tapped, as the pig iron required for the Bessemer process can be taken at any moment from the desulphurizing plant. In Hoerde, where the mixing and desulphurizing process has for a considerable time been regularly in use, it has been found that all the chief difficulties formerly encountered in the method of taking the fluid pig iron direct from the various blast furnaces to the converter have been obviated. At Hoerde the mixing and desulphurizing plant shown in the accompanying engravings is employed. This apparatus holds 70 tons of pig iron. It is, however, advisable to have an apparatus of greater capacity, say 120 tons. The apparatus has the shape of a converter, and the hydraulic machinery by which it is moved is simple and effective. An hydraulic pressure of eight atmospheres is sufficient to set it in motion. The vessel is provided with a double lining of firebricks of the same quality as those used for the lining of blast furnaces. This lining is gradually attacked only along the slag line, and does not require repair until it has been in use for some six weeks. Further repairs are then necessary every three weeks. Only the few courses of spoilt bricks are renewed, and for the repairs, including the cooling of the vessel, a period of two or three days is required. At the end of the week the vessel is kept filled, so that its contents suffice for the last charge to be blown on Saturday. On Sunday night the vessel is again filled. The consumption of manganese is very low; theoretically, it is the quantity required for the formation of manganese sulphide, and in practice it has been found that this amounts to about 0.2 per cent. The proportion of manganese which the desulphurized pig iron coming from the vessel should contain is best kept at about 1.5 per cent. in order to render the desulphurization as complete as possible. Thus, a mean proportion of 1.7 per cent. of manganese

BOOKRAGS

Page 63

in the pig iron passing into the vessel is more than sufficient to effect a thorough desulphurization. Indeed, 1 to 1.2 per cent. of manganese is sufficient to effect a satisfactory desulphurization. For the extent of the removal of the sulphur, the temperature and the duration of the reaction are of importance. It has been found that if highly sulphureted pig iron is poured from the blast furnace into the desulphurizing vessel, fifteen to twenty minutes are sufficient to effect the desulphurization requisite for the steel process. The part played by the duration of the process is seen from the results obtained with the last charges, if the vessel is emptied at the end of the week without fresh pig iron being added from the blast furnace. If, for example, 60 tons of pig iron with 0.065 per cent. of sulphur remain in the vessel, the proportion of sulphur with the last charges falls to 0.03 per cent. The iron in the vessel remains sufficiently fluid for several hours. When necessary, a little wood is thrown in. It has been found quite unnecessary to obtain heat by passing and burning a current of gas above the bath of metal.

A number of results, showing the separation of sulphur at the Hoerde Works, was published a few months ago[2] by Professor P. Tunner, one of our honorary members.

[Footnote 2: "Oesterreichische Zeitschrift fur Berg und Huttenwesen," 1891, No. 19.]

The totals represent, respectively, 138,500 kilogrammes of pig iron and 98,654 kilogrammes of sulphur.

Thus, from 138,500 kilogrammes of pig iron there has been eliminated 179,577-98,654 = 80,923 kilogrammes of sulphur, or, in other words, 45.063 per cent.

The proportion of sulphur in the slags rises with that in the iron from the blast furnace to 17 per cent., an inappreciable portion of the sulphur of the slag being oxidized to sulphurous anhydride by access of air. An analysis of the slag yielded the following results:

	Per cent.
Sulphur	17.07
Manganese	30.31
Phosphoric anhydride	0.61
Iron	7.13
Bases	35.04

An analysis of an average sample gave:

BOOKRAGS

	Per cent.
Manganese sulphide	28.01
Manganous oxide	20.23
Ferrous oxide	25.46
Silica	18.90
Alumina	5.00
Lime	3.53
Magnesia	0.43

The great convenience and certainty presented by the method described in this paper will in all probability lead to its general adoption. As a matter of fact, several works are now occupied with the installation of this mixing and desulphurizing plant.

* * * * *

ON THE OCCURRENCE OF TIN IN CANNED FOOD.

By H.A. WEBER, Ph.D.

Page 64

The following investigation of the condition of foods packed in tin cans was prompted by an alleged case of poisoning, which occurred at Mansfield, Ohio, in April, 1890. A man and woman were reported to the writer as having been made sick by eating pumpkin pie made from canned pumpkin. The attending physician pronounced the case one of lead poisoning. The wholesale dealer from whose stock the canned pumpkin originally came, procured a portion of the same at the house where the poisoning occurred, and sent it to the writer for examination.

The results of the examination as reported in Serial No. 552, below, showed that the canned pumpkin contained an amount of stannous salts equivalent to 6.4 maximum doses and 51.4 minimum doses of stannous chloride per pound. On being notified of this fact, the dealer sent a can of the same brand of pumpkin from his stock. The inner coating of the can was found to be badly eroded, and upon examination, as reported in Serial No. 563, below, one pound of the pumpkin contained tin salts equivalent to 7 maximum and 56 minimum doses of stannous chloride.

The unexpected large amount of tin salts in such an insipid article as canned pumpkin, and the claimed ill effects of the consumption of the same, suggested the advisability of extending the investigation to other canned goods in common use. Accordingly a line of articles was purchased in open market as sold to consumers, no pains being taken to procure old samples. The collection embraced fruits, vegetables, fish and condensed milk. With the exception of the condensed milk, every article examined was contaminated with salts of tin. In most cases the amount of tin salts present was so large that there can be no doubt of danger to health from the consumption of the food, especially if several kinds are consumed at the same meal.

METHOD.

The method employed in the determination of the tin was simply as follows:

The contents of each can were emptied into a large porcelain dish, and the condition of the inner coating of the can noted. After thoroughly mixing the contents, fifty grammes were weighed off and incinerated in a porcelain dish of suitable size. The residue was treated with a large excess of concentrated hydrochloric acid, evaporated to dryness, moistened with hydrochloric acid, water was added, and the mass was filtered and washed, the insoluble matter being all washed upon the filter. After drying the filter with its contents, the whole was again incinerated in a porcelain dish and the residue treated as before. The solution thus obtained was properly diluted and saturated with hydrogen sulphide. After standing about twelve hours in a covered beaker the precipitate was filtered off and the tin weighed as stannic oxide.

RESULTS OF EXAMINATION.

Serial No. 552.—Sample of canned pumpkin, received of F.A. Derthick, April 22, 1890, sent by Albert F. Remy & Co., Mansfield, Ohio. Pie made from it supposed to have made a man and woman sick. The attending physician pronounced the case one of lead poisoning.

BOOKRAGS

Page 65

	Per cent.
Tin dioxide with trace of lead	0.0424
Grains per pound	2.97
Equivalent to stannous chloride	3.74
Minimum doses	51.4
Maximum doses	6.4

Serial No. 563.—Sample of canned pumpkin, received of Edward Bethel, June 27, 1890. Labeled: Choice Pie Pumpkin, packed at Salem, Columbiana County, Ohio, by G.B. McNabb, sent by A.F. Remy & Co., Mansfield, Ohio.

	Per Cent.
Tin dioxide	0.0444
Grains per pound	3.11
Equivalent to stannous chloride	3.91
Minimum doses	56
Maximum doses	7

Can eroded.

Serial No. 565.—Sample of canned pumpkin, bought of T.B. Vaure, July 11, 1890. Labeled: Belpre Pumpkin, Golden. George Dana & Sons, Belpre, Ohio.

	Per Cent.
Tin dioxide	0.0054
Grains per pound	0.38
Equivalent to stannous chloride	0.48
Minimum doses	7.7
Maximum doses	1.0

Can eroded.

Serial No. 566.—Sample of canned Hubbard Squash, bought of T.B. Vaure, July 11, 1890. Labeled: Ladd Brand, L. Ladd, Adrian, Michigan.

	Per Cent.
Tin dioxide	0.026

BOOKRAGS

Grains per pound	1.85
Equivalent to stannous chloride	2.33
Minimum doses	37.00
Maximum doses	4.7

Can badly eroded.

Serial No. 567.—Sample of canned tomatoes, bought of T.B. Vaure, July 11, 1890. Labeled: Extra Fine Tomatoes. Blue Label. Curtice Bros. Co., Rochester, N.Y.

	Per Cent.
Tin dioxide	0.012
Grains per pound	0.84
Equivalent to stannous chloride	1.06
Minimum doses	16.00
Maximum doses	2.00

Inner coating eroded.

Serial No. 568.—Sample of canned tomatoes, bought of T.B. Vaure, July 11, 1890. Labeled: Fresh Tomatoes, Curtice Bros. Co., Rochester, N.Y.

	Per Cent.
Tin dioxide	0.014
Grains per pound	0.98
Equivalent to stannous chloride	1.23
Minimum doses	19.00
Maximum doses	2.5

Can eroded.

Serial No. 569.—Sample of canned peas, bought of T.B. Vaure, July 11, 1890. Labeled: Petites Pois, P. Emillien, Bordeaux.

	Per Cent.
Copper oxide	0.0294
Grains per pound	2.06
Equivalent to copper sulphate	3.95
Tin dioxide	0.0068
Grains per pound	0.48
Equivalent to stannous chloride	0.6

BOOKRAGS

Minimum doses	9.6
Maximum doses	1.2

No visible erosion.

Serial No. 570.—Sample of canned mushroom, bought of T.B. Vaure, July 11, 1890. Labeled Champignons de Choix. Boston fils. Paris.

BOOKRAGS

Page 66

	Per Cent.
Tin dioxide	0.02
Grains per pound	1.40
Equivalent to stannous chloride	1.76
Minimum doses	28.00
Maximum doses	3.50

Inner coating highly discolored.

Serial No. 571.—Sample of canned blackberries, bought of T.B. Vaure, July 11, 1890. Labeled: Lawton Blackberries. Curtice Bros. Co., Rochester, N.Y.

	Per Cent.
Tin dioxide	0.0114
Grains per pound	0.80
Equivalent to stannous chloride	1.01
Minimum doses	16.00
Maximum doses	2.00

Inner coating eroded.

Serial No. 572.—Sample of canned blueberries, bought of T.B. Vaure, July 11, 1890. Labeled: Blueberries. Eagle Brand, packed by A. & R. Loggie, Black Brook, N.B.

	Per Cent.
Tin dioxide	0.03
Grains per pound	2.10
Equivalent to stannous chloride	2.64
Minimum doses	42.00
Maximum doses	5.30

Can badly eroded.

Serial No. 574.—Sample of canned salmon, bought of T.B. Vaure. July 11, 1890. Labeled: Best Fresh Columbia River Salmon, Eagle Canning Co., Astoria Clatsop Co., Oregon.

BOOKRAGS

	Per Cent.
Tin dioxide	0.0134
Grains per pound	0.94
Equivalent to stannous chloride	1.18
Minimum doses	18.90
Maximum doses	2.30

Inner coating eroded.

Serial No. 578.—Sample of canned pears, received of Mr. Edward Bethel, July 29, 1890. Labeled: Bartlett Pears. Solan's Brand, packed in Solano Co., California.

	Juice. Per Ct.	Fruit. Per Ct.
Tin dioxide	0.0074	0.0074
Grains per pound	0.5180	0.5180
Equivalent to stannous chloride	0.65	0.65
Minimum doses	10.40	10.40
Maximum doses	1.30	1.30

Can eroded.

Serial No. 579.—Sample of canned peaches, received of Edward Bethel, July 29. 1890. Labeled: Peaches, Wm. Maxwell, Baltimore, U.S.A.

	Juice. Per Ct.	Fruit. Per Ct.
Tin dioxide	0.0324	0.0414
Grains per pound	2.2680	2.8980
Equivalent to stannous chloride	2.85	3.65
Minimum doses	45.60	58.40
Maximum doses	5.70	7.30

Can badly eroded.

Serial No. 580.—Sample of canned blackberries, received of Edward Bethel, July 29, 1890. Labeled: Blackberries, Clipper Brand, Wm. Munson & Sons, Baltimore, Md.

	Per Cent.
Tin dioxide	0.06
Grains per pound	4.20
Equivalent to stannous chloride	5.28
Minimum doses	84.00
Maximum doses	10.60

Can badly eroded.

Page 67

Serial No. 581.—Sample of canned cherries, received of Edward Bethel, July 29, 1890. Labeled: Red Cherries, Cloverdale Brand, G.C. Mournaw & Co., Cloverdale, Va.

	Per Cent.
Tin dioxide	0.0414
Grains per pound	2.8980
Equivalent to stannous chloride	3.65
Minimum doses	58.40
Maximum doses	7.30

Can badly eroded.

Serial No. 582.—Sample of canned pumpkin, received of Edward Bethel, July 29, 1890. Labeled: Royal Pumpkin, Urbana Canning Co., Urbana, O.

	Per Cent.
Tin dioxide	0.0184
Grains per pound	1.2990
Equivalent to stannous chloride	1.62
Minimum doses	25.90
Maximum doses.	3.20

Can eroded.

Serial No. 583.—Sample of canned baked sweet potatoes, received of Edward Bethel, July 29, 1890. Labeled: Tennessee Baked Sweet Potatoes, Capital Canning Co., Nashville, Tenn.

	Per Cent.
Tin dioxide	0.0132
Grains per pound	0.92
Equivalent to stannous chloride	1.16
Minimum doses	18.50
Maximum doses	2.30

Can eroded.

BOOKRAGS

Serial No. 584.—Sample of canned peas, received of Edward Bethel, July 29, 1890. Labeled: Marrowfat Peas, Parson Bros., Aberdeen, Maryland.

	Per Cent.
Tin dioxide	0.0044
Grains per pound	0.30
Equivalent to stannous chloride	0.38
Minimum doses	6.20
Maximum doses	0.80

Can slightly eroded.

Serial No. 585.—Sample of string beans, received of Edward Bethel, July 29, 1890. Labeled: String Beans. Packed by H.P. Hemingway & Co., Baltimore City, Md.

	Per Cent.
Tin dioxide	0.0154
Grains per pound	1.08
Equivalent to stannous chloride	1.36
Minimum doses	21.70
Maximum doses	2.70

Can eroded.

Serial No. 586.—Sample of canned salmon, received of Edward Bethel, July 29, 1890. Labeled: Puget Sound Fresh Salmon, Puget Sound Salmon Co., W.T.

	Per Cent.
Tin dioxide	0.0044
Grains per pound	0.30
Equivalent to stannous chloride	0.38
Minimum doses	0.20
Maximum doses	0.80

Can slightly eroded.

Serial No. 587.—Sample of condensed milk, received of Edward Bethel, July 29, 1890. Labeled: Borden's Condensed Milk. The Gail Borden Eagle Brand, New York Condensed Milk Co., 71 Hudson Street, New York.

Tin dioxide none.

No visible erosion.

Serial No. 592.—Sample of canned pineapples, bought of Mr. Brown, Fifth Avenue, August 4, 1890. Labeled: Pineapples, First Quality. Packed by Martin Wagner & Co., Baltimore, Md.

BOOKRAGS

Page 68

Per Cent.	
Tin dioxide	0.0098
Grains per pound	0.6860
Equivalent to stannous chloride	0.8640
Minimum doses	13.6
Maximum doses	1.7

Can eroded

Serial No. 593.—Sample of canned pineapples, bought of Mr. Brown, Fifth Avenue, August 4, 1890. Labeled: Florida Pineapple, Oval Brand. Extra Quality. A Booth Packing Co., Baltimore, Md.

Per Cent.	
Tin dioxide	0.0158
Grains per pound	1.11
Equivalent to stannous chloride	1.40
Minimum doses	22.40
Maximum doses	2.80

Can eroded.

—*Jour. Amer. Chem. Soc*.

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NEW PROCESS FOR THE MANUFACTURE OF CHROMATES.

By J. MASSIGNON and E. VATEL.

The ordinary method of manufacturing the bichromates consists in making an intimate mixture of finely pulverized chrome ore, lime in large excess, potash or soda, or corresponding salts of these two bases. This mixture is placed in a reverberatory furnace, and subjected to a high temperature, while plenty of air is supplied. During the operation the mass is constantly puddled to bring all the particles into contact with the hot air, so that all the sesquioxide of chromium of the ore will be oxidized. After the oxidation is finished, the mass is taken from the furnace and cooled; the bichromate is

obtained by lixiviation, treated with sulphuric acid and crystallized. This method of manufacture has several serious objections.

The authors, after research and experiment, have devised a new process, following an idea suggested by Pelouze.

The ore very finely pulverized is mixed with chloride of calcium or lime, or carbonate of calcium, in such proportions that all the base, proceeding from the caustic lime or the carbonate of calcium put in the mixture, shall be in slightly greater quantity than is necessary to transform into chromate of calcium all the sesquioxide of chromium of the ore, when this sesquioxide will be by oxidation changed into the chromic acid state. The chloride of calcium employed in proportion of one equivalent for three of the total calcium is most convenient for the formation of oxychloride of calcium. If the mixture is made with carbonate of lime (pulverized chalk), it will not stiffen in the air; but if lime and carbonate of calcium are employed at the same time, the mass stiffens like cement, and can be moulded into bricks or plates. The best way to operate is to mix first a part of the ore and well pulverized chalk, and slake it with the necessary concentrated chloride of calcium solution; then to make up a lime dough, and mix the two, moulding quickly. The loaves or moulds thus formed are partially dried in the air, then completely dried in a furnace at a moderate temperature, and finally baked,

Page 69

to effect the reduction of the carbonate of calcium into caustic lime. It is only necessary then to expose the loaves to the air at the ordinary temperature, for the oxidation of the sesquioxide of chromium will go on by degrees without any manipulation, by the action of the atmospheric air, the matter thus prepared having a sufficient porosity to allow the air free access to the interior of the mass. Under ordinary conditions the oxidation will be completed in a month. The division of this work—mixing, slaking or thinning, roasting or baking, and subjection to the air—is analogous to the work of a tile or brick works. The advance of the oxidation can be followed by the appearance of the matter, which after baking presents a deep green color, which passes from olive green into yellow, according to the progress of calcium chromate formation. When the oxidation is completed, the mass contains: Chromate of calcium, chloride of calcium, carbonate of lime and caustic lime in excess, sesquioxide of iron and the gangue, part of which is united with the lime. This mass is washed with water by the ordinary method of lixiviation, and there is obtained a concentrated solution containing all the chloride of calcium, and a small quantity only of chromate of calcium, the latter being about 100 times less soluble in water.

This solution can be used in the following ways:

1. It can be concentrated and used in preparing a new charge, the small quantity of calcium chromate present being an assistance, or:

2. It can be used for making chromate of lead (chrome yellow), by precipitating the calcium chromate with a lead salt; this being a very economical process for the manufacture of this color.

The mass after lixiviation, being treated with a solution of sulphate or carbonate of potash or soda, will yield chromate of potash or soda, and by the employment of sulphuric acid, the corresponding bichromates. The solutions are then filtered, to get rid of the insoluble deposits, concentrated, and crystallized.

If, instead of chromate or bichromate of potash or soda, chromic acid is sought, the mass after lixiviation is treated with sulphuric acid, and the chromic acid is obtained directly without any intermediate steps.

This process has the following advantages:

1. The oxidation can be effected at the ordinary temperature, thus saving expense in fuel.

2. The heavy manual labor is avoided.

3. The loss of potash and soda by volatilization and combination with the gangue is entirely avoided.

4. It is not actually necessary to use rich ores; silicious ores can be used.

5. The intimate mixture of the material before treatment being made mechanically, the puddling is avoided, and in consequence a greater proportion of the sesquioxide of chromium in the ores is utilized.—*Bull. Soc. Chem.* 5, 371.

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Page 70

A VIOLET COLORING MATTER FROM MORPHINE.

A violet coloring matter is formed, together with other substances, by boiling for 100 hours in a reflux apparatus a mixture of morphine (seven grammes), p-nitrosodimethylaniline hydrochloride (five grammes), and alcohol (500 c.c.). The solution gradually assumes a red brown color, and a quantity of tetramethyldiamidoazobenzene separates in a crystalline state. After filtering from the latter, the alcoholic solution is evaporated to dryness, and the residue boiled with water, a deep purple colored solution being so obtained. This solution, which contains at least two coloring matters, is evaporated almost to dryness, acidulated with hydrochloric acid, and then rendered alkaline with sodium hydrate, the coloring matters being precipitated and the unchanged morphine remaining in solution. The precipitate is collected on a filter, washed with dilute sodium hydrate, dried, and extracted in the cold with amyl alcohol, which dissolves out a violet coloring matter, and leaves in the residue a blue coloring matter or mixture of coloring matters. The violet coloring matter is obtained in a pure state on evaporating the amyl alcohol. Its platinochloride has the formula PtCl_{4}.C_{25}H_{29}N_{3}O_{4}.HCl, and has the characteristic properties of the platinochlorides of the majority of alkaloids. The coloring matter, of which the free base has the formula—

(C_{6}H_{4}N(CH_{3})_{2})—&
shy;N==(C_{17}H_{19}NO_{4})

forms an amorphous mass with a bronze-like luster; it is sparingly soluble in water, freely so in alcohol, its alcoholic solution being strongly dichroic; its green colored solution in concentrated sulphuric acid becomes successively blue and violet on dilution with water; it dyes silk, wool, and gun cotton, but is not fast to light.

Morphine violet is the first true coloring matter obtained from the natural alkaloids, the morphine blue of Chastaing and Barillot (Compt. Rend., 105, 1012) not being a coloring matter properly so called. —*P. Cazeneuve, Bull. Soc. Chim.*

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LIQUID BLUE FOR DYEING.

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Page 71

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