MECHANICS, PHYSICS, AND CHEMISTRY.

*On the Connexion between the Structure and the Physical Properties of Wood.** By Prof. KNOBLAUCH.

From the "Sitzungsberichte der Naturforschenden Gesellschaft." Halle, 1858, vol. v.

The author seeks to ascertain *whether any connexion is ascertainable between the structural relations of various kinds of wood and their observed physical properties, such as their powers of resonance and conduction of heat, &c.*, in the same way as was done for one and the same wood by Savart in respect to resonance, and more especially by Tyndall in respect to the conduction of heat.

The primary object was to trace the difference in the conduction of heat shown by different woods, according as the heat has to traverse the wood in a direction parallel with, or at right angles to, the direction of the grain. For this purpose, slabs of the woods to be examined were bored through perpendicular to their planes, and then covered as uniformly as possible with a coating of stearine. A hot wire, exactly fitting the bore, was introduced into the latter and continually turned round during the experiment. By this means the coating of stearine around the orifice was melted; but, as we should expect, not in concentric circles, but in elliptic zones, whose major axes invariably coincided with the direction of the grain. The great difference in the behavior of different kinds of wood (about eighty sorts were examined,) under these circumstances is at once apparent. With some the ellipses are tolerably circular, by others more elongated, while by others, again, the major axes are so extended as to be nearly twice the length of the minor ones. The eccentricity of these ellipses, which furnished a graphical expression for the conductive power of the wood in the directions between which the structural difference was greatest, made it possible to divide the different kinds of wood into four distinct groups. In the first, the ratio of the minor to the major axis of the ellipse is on the average as 1 to 1·25. To this group, Acacia, Box, Cypress, King-wood, &c., belong. In the second, and by far the most numerous group, containing Elder, Nut, Ebony, Apple, several dye-woods, &c., the mean value of this ratio is 1 to 1·45. In the third group, to which Apricot, Siberian, Acacia, Brazil wood, Yellow wood from Puerto Cabello, &c., belong, the ratio is as 1 to 1·60. In the fourth group it is as 1 to 1·80, and to this division belong Lime, Tamarind, Iron wood, Poplar, Savanilla (yellow), &c. Hence, *the conducting power of all woods in the direction of the fibre exceeds that in the perpendicular direction by no means in a constant manner, but in one which depends upon the nature of the wood.* This superiority is in the first group so small, that the warmth in the direction of the fibre traverses a path only a quarter more in length than that traversed in the same time in a perpendicular direction. In the last group, on the other hand, the length of the path in the first direction is about twice that in the perpendicular one.

* From the Lond., Edin., and Dub. Mag., May, 1859.

In order to investigate the relations of resonance, two rods were cut from each kind of wood,—the one being taken in the direction of the grain (Langholz), the second perpendicularly across it (Hirnholz). On suspending these rods freely (their length was 470 millims., breadth 20 millims., and thickness 8 millims.) and striking them with a stick, the piece cut with the grain always gives a more sonorous tone than the corresponding cross-grain piece. Nevertheless, the difference of resonance in the tones of the width and cross-grain pieces of one and the same wood, of the first of the groups described (say beech), is unmistakably less than the difference between the tones of the with and cross-grain pieces of any member of the second group. In the second group this difference is less than in the third; and in the third, again, less than in the fourth (as with with- and cross-grain pieces of poplar). *When, therefore, the fibres of all kinds of wood are set in vibration, the purity of resonance is greater when such vibrations are transverse than when they occur in other directions (as when the rods are cut across the grain). But this superiority of resonance is not constant; it depends upon the nature of the wood.* The difference in this respect in the first group of woods is so small, that the resonance of two with- and cross-grain pieces resembles that of two not very dissimilar masses of stone when struck. In the last group the difference is so great, that the tone of the with-grain piece when struck has a metallic ring, while the dull sound of the cross-grain piece reminds one of a piece of pasteboard when struck. *The division of the woods examined, derived from their thermo-conductive power, is accordingly supported by their acoustic relations.*

By supporting the two ends of the rods employed in the above experiments and loading them equally in the middle, the degrees of deflexion which they undergo will give us an insight into their structural relations; for the greater their compactness, the greater the resistance they will offer to bending; and the less compact they are, the more easily will they yield. The difference in vertical height of the middle points of the bent and straight rods was taken as measure of deflexion. A lever was employed to determine this measure, the end of which passed over an enlarged scale in order that the readings off might be the more exact. The unit of this measure was a matter of indifference, inasmuch as in the comparison to be instituted, relations only had to be determined. Although, as was to be expected, in all cases the with-grain piece was much less flexible than the corresponding cross-grain piece, yet an important difference was noticeable in the different groups. This is best seen by calculating the relation between the bending (measured as above described,) of the with-grain and that of the cross-grain wood; that is, the same weight being applied (say 100 grs.), by dividing the number given by the lever with the cross-grain piece by that given with the with-grain piece. This relation (called "ratio of deflexion" in the following Table) has, in the first group, the mean value of 1 to 5; in the second, 1 to 8; in the third, 1 to 9·5; in the fourth, 1 to 14. The division of the groups is therefore also supported from this point of view.* *The difference in the structure in the different directions is least in those woods which show the least difference with respect to direction in their thermoconductive and resonant properties; and the difference in the former is greater or less as the two latter differences are greater or less.*

Hence, a definite relation may be established between the different phenomena described; and this is true to such an extent, that the knowledge of one of them, e. g., *the mechanical or state of cohesion is sufficient to deduce the others, those of warmth or resonance.*

Thus, merely to adduce one example, especial experiments had shown that in petrified woods a difference of structure in the directions parallel with, and perpendicular to, the direction of the grain had been preserved, and, in fact, the thermal curve was an ellipse whose major axis was parallel to the fibres. As in the petrified example, this difference in mechanical structure was much less than in the living wood, so, also, while in the living Conifer the ratio of the axes was as 1 to 1·80, in the petrified specimen it had sunk to 1 to 1·12.

The following Table contains the names of the woods examined, arranged according to the groups mentioned:—

GROUP I.

Ratio of the axes of the thermal ellipse 1 to 1·25. Mean ratio of deflexion 1 to 5·0.

Acacia.	King wood.
Box.	Satin wood.
Lignum-vitæ.	Salisburia (*Gingko*).
Cypress.	

GROUP II.

Ratio of axes of thermal ellipse 1 to 1·45. Mean ratio of deflexion 1 to 8·0.

Elder.	Snake wood.
Alder.	Zebra wood.
White Thorn.	Purple wood (*Amaranthus*).
Arbor vitæ.	Settin.
St. Lucian wood.	Coromandel wood.
Gymnocladus canadensis.	Angica wood.
Beech (2 species, white and red).	Cocoa wood (*Gateado*).
Plane.	Apple.
Elm.	Pear.
Oak (two species).	Cherry.
Ash.	Plum.
Maple.	Sandal (red).
American maple.	Caliatour.
Cedar of Lebanon.	Costarica (red wood).
Australian cedar.	Bimas sapan.
Mahogany.	Cuba (yellow wood).
Palisander.	Viset (yellow wood).
Ebony.	Campeachy blue wood.
Palm.	Tobasco blue wood.
Rosewood.	Domingo blue wood.

GROUP III.

Ratio of axes of thermal ellipse 1 to 1·50. Mean ratio of deflexion 1 to 9·5.

Apricot.	Pernambuco red wood.
Pistachio.	Japan red wood.
Siberian Acacia.	Puerte-Cabello yellow wood.

* The diversity of nature, even with one and the same kind of wood, of course did not admit of the boundaries of the groups being drawn with great exactness, or of the subdivision of the groups into secondary ones.

GROUP IV.

Ratio of the axes of the thermal ellipse 1 to 1·8. Mean ratio of deflexion 1 to 14·0.

Willow (two examples).	Weymouth fir.
Chestnut (three examples).	Magnolia.
Lime.	Iron wood.
Alder.	Tamarind.
Birch.	Palmassu.
Poplar (three examples).	"Kistenholz."
Aspen.	Caoba (Havanna Cedar).
Pine.	Savanilla yellow wood.
Fir.	

*Electro-telegraphic Progress.**

A foreign scientific journal gives the following summary of the different lines where submarine telegraphs have been laid, up to the end of 1858.

Dates.		Length in miles.
1850.	England and France,	22¼
1852.	England and Belgium,	70¾
"	England and Ireland,	64
1853.	England and Holland,	107½
"	Ireland and Scotland,	24¾
1854.	Italy and Corsica,	64
"	Corsica and Sardinia,	9¼
"	Denmark (Great Belt),	14¼
"	Denmark (Little Belt),	4¾
1855.	Denmark (Channel of the Sound),	11⅛
"	Scotland (Frith of Forth),	3½
"	Black Sea,	371¼
"	Solent (Isle of Wight),	3
1856.	Straits of Messina,	4¾
"	Gulf of St. Lawrence,	74
"	Strait of Northumberland,	9¼
"	The Bosphorus,	1⅛
"	Nova Scotia (Isthmus of Canso),	1¾
"	St. Petersburgh and Cronstadt,	8
1857.	Sicily and Algeria,	149½
1858.	Bay of Valentia (Ireland) and that of Trinity (America),	1827¼
	Total in 1858,	2771¼

* From the Lond. Builder, No. 844.

Use of Birds.

The *Bulletin* of the Brussels Society for the protection of animals, published the following curious and interesting fact:

Until a few years ago, the Park at Brussels was shaded by trees of luxuriant foliage which met over the alleys and screened the promenaders entirely from the sun. These trees were filled with birds whose indiscretions occasioned now and then a little annoyance to the elegant toilettes below. For this reason they were banished; in a few weeks, the leaves of the trees were in holes and dying—and now, the branches almost entirely without verdure, and loaded with caterpillars, and the walks infested with moths. *Cosmos.*

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*On Professor Hughes' System of Type-printing Telegraphs and Methods of Insulation, with special reference to Submarine Cables.** By Mr. H. Hyde.

The several phenomena which have been manifested in the working of long submarine telegraph cables, demonstrate the necessity of improving the insulation of the wires, and of economizing the transmission and recording of symbols. Imperfect insulation not only implies a diminution of the electric current, but may, and frequently does, increase to a total loss, and the cable becomes useless.

The insulation being good when the cable leaves the manufacturer, it is subject to so many accidents before it reaches the bottom of the ocean, that the chances are greatly in favor of a long line receiving some damage, which cannot be repaired after it is laid down. More perfect insulation, and a self-restoring power which should make the cable itself, even at the bottom of the ocean, repair any accidental defect, are most important desiderata in the science of ocean telegraphing.

The great expense of a length of cable, of any construction, sufficient to join England and America, must necessarily be such as to render economy of time in the transmission of messages a matter of primary importance.

Through a single wire, the waves of the electric force can only follow one another in single file. Whatever may be the time occupied in the transmission of a single wave, it is of no small importance, whether it takes from five or six, or only a single wave, to communicate the signal of any letter of the alphabet. The short experience of the working of the Atlantic cable has demonstrated the importance of these positions. I need therefore offer no apology to the members of the Society of Arts, for bringing before them the methods by which Prof. Hughes seeks to improve the insulation of submarine and other wires, to render them self-repairing, and to economize and render at the same time the means of despatch accurate and self-recording.

First—Insulation.—Gutta-percha has been found to be the best insulation for long submarine lines. This substance, however, is more or less porous; minute flaws may exist, which do not show themselves until some time after the immersion of a cable. This was exemplified by Mr. Henly, who discovered a flaw in his submarine cable, which did not show itself until it had been three or four days under water. To meet these defects, to fill up any minute pores in the gutta-percha, and also to cure any accidental fracture or puncture of it, Prof. Hughes introduces a viscid semi-fluid substance, of a non-conducting character, between the conducting wire and the gutta-percha, or the wire may be first coated with gutta-percha, and the viscid fluid introduced between the layers of gutta-percha. As soon as a puncture is

* From the Jour. of the Society of Arts, No. 321.