EL BARON DE HUGHES.

Under this title we find in a recent number of *La Ilustracion Española*, a handsome illustrated paper published at Madrid, a finely executed portrait and a flattering notice of our ingenious countryman, Mr. E. D. Hughes, of Kentucky. The Spanish government has lately adopted the Hughes printing telegraph instruments,and their successful working gives so much satisfaction that the king has conferred a titulary nobility upon the inventor. "The Baron of Hughes" is the new name of our fellow citizen.

By the help of photography we have reproduced the portrait of the baron, and present it herewith, together with some of the good words given by R. de Morines, the writer in *La Ilustracion.*

"Our readers will have learned from the city papers that the Spanish goverment has, at last, decided to adopt for service on its long telegraph lines, the printing instrument invented by Sir Hughes.

"The nature of our publication and the limited space at our disposal will not permit us to give a full description of the system to which we refer. We are obliged to omit details, and simply say that the principle upon which it is founded is the isochronous or movement in unison,of type wheels,obtained by means of a vibrating plate which serves as a regulator. Our readers must suppose one of the said type wheels to be located in the station at Madrid and the other at Paris; that the two revolve in unison; and that at the beginning of their movements, the letter A, for example, in both instruments, stands directly in front of a hammer, which, on the passage of the electric current through the bobbin of an electro-magnet, strikes upon a ribbon of paper, interposed between the hammer and the type wheel. If, at this instant, the operator at Madrid presses with his finger the key which establishes contact with the battery, the electric current will pass over the line, through the magnet bobbin, and into the earth; the plate will move and give motion to the hammer, which, by pressing the paper against the letter A, effects an impression thereof on the paper, provided the type has been suitably inked.

As the velocity of the electric current may be considered unlimited over a distance relatively very small. the same letter will, at the same time, be printed in Paris, if, as before stated, the letter A, in both instruments, stands at the same instant in front of the printing hammers. If instead of A the letter D stands in said position, then that letter will be printed, and so on.

"Such in brief is the principle of the system so ingeniously worked out by Sir Hughes. Its chief advantages are rapidity and correctness in transmission, the delivery of the message in ordinary print, and the great distance over which the messages may be directly transmitted.

"The genius of the inventor, his perseverance under all difficulties, twenty years of study and experiment, a hundred thousand dollars in money spent in realizing the first imperfect but still useful apparatus, the endurance, without dismay, of all the hardships and mischances that beset every man of talent who seeks to raise himself above the common level—these have crowned, with a most happy conclusion, a discovery which has yielded to its author glory, honors, and fortune.

"Sir Don Edward David Hughes,whose portrait we herewith publish, was born in 1831, in Louisville, Ky., one of the States of North America. From a very early age, he devoted himself to the study of the physical, mathematical, and mechanical sciences. At the age of 19 years he was professor of physics in the College of Kentucky, and in the same year (1850) began his studies upon the instrument which today bears his name.

"In 1855 the American Telegraph Company first adopted the Hughes system. In 1861 it was adopted in France, and, successively, in Italy and England in 1862, Russia 1865, Prussia 1866, Austria, Hungary, and Turkey 1867, Holland 1868, Bavaria and Wurtemburg 1869, Switzerland and Belgium 1870, Peru 1871, Buenos Ayres 1872, the English Submarine Company 1873, the Argentine Confederation 1874, Spain 1875.

"We give thanks for the example and zeal of the Government Ministers, and the worthy Director General of Telegraphs, in that,having overcome all obstacles, administrative and routine, they have introduced into our country so useful an improvement,at a time when it is so much needed by the daily increasing necessities of the telegraphic service. We tender our congratulations to them and the public, who will very soon begin to experience the advantages of this wonderful invention.

"Sir Hughes is a member of almost all the scientific academies of Europe. He received the great gold medal at the Universal Exposition at Paris in 1867. He is knight commander and holds the grand cross of the order of San Miguel and of the Iron Crown. He has been decorated with the cross of the Legion of Honor,of Medjidie, of Santa Anna, of San Mauricio, and San Lazaro, etc. The Spanish government has decorated him with the commandery of Carlos III. The greater part of the sovereigns of Europe have honored him by their personal visits.

"As we have already stated,Sir Hughes has had the good fortune to realize in life that which few men of his stamp ever enjoy,namely, the pleasure of being useful to humanity, and of receiving honors, glory, and a considerable fortune. Nevertheless, Sir Hughes, like all men of real merit, is modest and simple,qualities which enhance his native worth and attract the sympathies of all who have the happiness of knowing or dealing with him.

"Taking advantage of his presence among us, we publish his portrait, and through the columns of our periodical we give him a welcome."

A California Tree for the Centennial.

Some time ago we mentioned the fact that Mr. Vivian was preparing a large piece of one of the Tulare county big trees to exhibit at the Centennial next year. The piece of timber selected will be sixteen feet long, and twenty-one feet in diameter at one end and nineteen feet at the other. The heart of this will be taken out, leaving only about one foot of the body of the tree attached to the shell or bark. This outside shell will then be divided into eight equal parts, each of which will weigh four thousand pounds without the bark. It is necessary to divide it into this number of parts in order to allow it to pass through the numerous tunnels between here and Philadelphia. The eight parts will weigh about thirty thousand pounds, and will require two cars for their transportation. One solid foot of this tree weighs seventy-two pounds, being ten pounds heavier than so much water. This timber was taken out of the General Lee, a tree two hundred and seventy-five feet high, and which, had it been sawn into lumber, would have produced a sufficient quantity to have built a very respectable young town or a large ship. It contained more than two hundred thousand feet of lumber, besides, probably, about two hundred cords of wood. The General Grant, a much larger tree than the General Lee, and the largest in the world, growing in the same grove, is left standing, probably for the benefit of future.—*Visalia (Cal.) Delta.*

EDWARD DAVID HUGHES.
INVENTOR OF THE HUGHES PRINTING TELEGRAPH.

Progress of Telegraphy.---One Wire for Many Instruments.

The *Golos* announces the arrival at St. Petersburgh of M. La Cour, assistant-director of the Copenhagen Physical Observatory, in order to submit to the telegraphic conference a new invention in telegraphy. That invention gives the possibility of transmitting despatches between two telegraphic stations through one wire only, and by means of many instruments, so that transmission by one instrument cannot impede the action of the other. M. La Cour, while engaged some years ago in investigating the passage of electric currents through conducting media, found that electricity is transmitted from place to place by undulations analogous to those of sound. In consequence of this discovery, he hit upon an arrangement of electro-magnets and tuning forks, by means of which a particular current passing through a tuning fork pitched to a certain note does not become merged in or confounded with other currents which, after passage through differently pitched tuning forks, are simultaneously transmitted along the same wire. This, of course, renders it possible to send many messages at a time through a single wire. —*The Telegraphic Journal.*

THE CENTER OF OUR POPULATION.—It has traveled westward, keeping curiously near the 39th parallel of latitude, never getting more than 20 miles north, nor two miles south of it. In the 80 years it has traveled only 400 miles, and is still found nearly 50 miles eastward of Cincinnati.

Salicylic and Benzoic Acids.

Professor Salkowsky of Berlin has recently made some experiments which are not so favorable to salicylic acid as those previously reported. The *Industrie Blätter* gives the following *resumé* of his experiments: Salicylic acid, in concentrated aqueous solution, puts off decay but is not able to prevent it. Salicylic acid does not possess any deodorizing properties, although it has been supposed to. Decomposing liquids when mixed with salicylic acid solution retain their odor unchanged. In fact it is difficult to see how it could deodorize, for this action can only be effected in one of three ways: first, by destroying the volatile substances that rise from the liquid; permanganate of potash, chloride of lime, and sulphurous acid deodorize in this way. Second, by absorbing these substances, as does charcoal, and to a less degree other porous bodies, like peat and plaster of Paris; to this class also belong those substances which precipitate aluminous matters. Third, by concealing the foul odor, as does carbolic acid. Salicylic acid does not possess strong chemical affinities, nor form precipitates, nor yet possess an odor of its own. The action of salicylic acid is not due to its splitting up into carbolic acid and carbonic acid, as Kolbe originally supposed. The untenableness of of this supposition is evident from the fact that salicylic acid acts when much less concentrated than carbolic acid. Besides, it is easily extracted from the mixture by means of ether,and no carbolic acid can be detected in it.

Benzoic acid possesses much stronger antiseptic properties than salicylic acid. According to the author's experiments, if fresh meat,either finely chopped or in larger pieces,be kept in a concentrated aqueous solution, no decomposition sets it at all for more than 3 months. The liquid remains perfectly clear and retains the odor of benzoic acid. Kolbe found benzoic acid less active than salicylic acid. "I thought at first," says he, "that the difference could lie in the different sources of the acids employed. Benzoic acid made from gum benzoin has a strong aromatic odor, which is due to a minute quantity of some other admixture which has not yet been studied. Benzoic acid prepared from the urine of cattle and horses has also an odor, but not so intense and rather different from the former. Now it was supposable that this minute admixture had an effect upon its antiseptic properties, but some of the latter acid, labeled *acidum benzoicum ex urina*, was just as active as the former kind."

As regards the practical use of salicylic acid externally, the fact that it does not entirely prevent decay is of little consequence, for, other things being equal,people always prefer that which offers perfect protection against decomposition. Benzoic acid is decidedly cheaper* than salicylic, which is a strong point in its favor. Whether in its employment it possesses disadvantages over salicylic acid, or advantages over carbolic acid,can only be learned by clinical experience.

Both acids are alike unsuited for internal use as antiseptics or antizymotics, because when taken into the blood they are converted into the soda salts. It is evident that here the use of neutral substances is far preferable, such as pass unchanged through the system; in fact this is the principal condition of their effectiveness. As a type of these we may mention phenol (carbolic acid) and substitution products of phenol, all of which exert,to greater or less degree, a strong antiseptic action, such as thymol. The ether of phenol is also an antiseptic.

The Spiritual Scientist.

Most of the organs of the spiritualists in this country are filled with insipid ghost matter, very tiresome and useless to all whose brains have not been softened by the spirit craze. The *Spiritual Scientist*, a neatly printed weekly periodical, is an exception. Its editorial columns exhibit talent, while its conductors, with a boldness quite remarkable for a spirit paper, actually condemn, as unworthy of true believers, the printing and circulation of the unauthenticated trashy stuff delivered by common mediums. To its cotemporary the *Banner of Light*, it administers a severe rebuke for its agency in this matter, and alleges that for the past ten or twelve years that journal has poured out a weekly stream of pretended spirit communications, of which not more than two in a hundred had any evidence of being genuine, or contained anything beyond childish nonsense, the merest babbings of infancy. It thinks the time has now come to substitute the intelligent speech of adolescence, which it accordingly undertakes to do in its next article.

Subject: The American Association for the Advancement of Science, now in session at Detroit.

Disgraceful behavior of the Association and of individual members thereof, towards spiritual science, are charged on the following specifications:

"If," says the *Scientist*, "these learned children would simply confess their ignorance of spiritual facts, laws, and philosophy, we could have nothing to complain of. But what the whole spiritualistic press and all intelligent spiritualists so indignantly denounce is the fact that scientific men, like Davy, Faraday, Tyndall, and Huxley, pronounce upon these matters without being possessed of any data upon which to form an opinion. Worse, they sometimes have de liberately lied about observed phenomena, to avoid making

*Benzoic acid sells for 25 cents per ounce, artificial salicylic acid 50 cents per ounce, in New York city.

a favorable report. If any of them feels aggrieved at our language, let him say so, and we will prove its literal accuracy."

"The helpless creatures are only human moles. As they burrow in their 'dim galleries,' what can they know of the inner world, which their predecessors only discovered at the moment when communication was interrupted between them and their fellow grubbers?"

"See what will happen at this Detroit meeting: Their Entomological Club will have heated debate upon trapdoor spiders, and acrimoniously discuss whether the male *mygale avicularia* has a darker shade of brown than the female on the upper segment of the body, and more ciliæ to the square inch; after which, as an appetizer for dinner (champagne and fixings on the lake), mention will be made of that Dismal Swamp louse, which (see Trans. 1874) the surveyors found always pointing its nose to the north, whichsoever way they might lay it down. Professor Hilgard will enquire, across the room, of Professor Dawson, whether the Myriapoda with two antennæ, so highly esteemed by the scolopendra tribes of India, are more nutritious than the date palm. Professor Youmans will propose to the Club the election to honorary membership of the "correspondent of the Department of Agriculture" whose discovery of mortality among bots, upon the application of a decoction of tansy he had appropriately noticed at page 384, Vol. VII, No. 39 of *Popular Science Monthly*. Professor E. B. Elliot will show that he was right and Professor H. E. Davis wrong in the number of young *lepidoptera* which, when placed end to end, will measure a mile, —the true figures being 0174 x b—y542½ = A's³.

"The anthropological subsection will no doubt give prominence to a discussion upon measles as a religious element among the Andamanese; and an adjournment could hardly be reached without a fight over the old puzzle, whether it is probable that the American stovepipe represents the form of the prayer cylinder of the lacustrians. If Professor Buchanan, who has forgotten more about anthropology than any of them ever know, should attempt to crowd upon them the complete study of man in all his relations, he will be coughed down and the floor granted to somebody who has a speech ready upon the reticulated button hole of the Bengalese Rajpoot's coat. And yet they are not happy.

"Have we done any injustice to the American and British Associations—for they are both alike? Consult the printed volumes of *Transactions*, in which may be found a record of some of the very papers above enumerated, and others about orange peel oil, fat women, hyena's dens, and the blastoderms of birds' eggs.

It is their own affair whether they study this or that science, and prefer to use the few hours they have on earth in discovering the nature of the respiratory organs of the shark or any other ignoble tomfoolery, to studying the spiritual part of Man and his intermundane communications, attractions, and perils."

[For the Scientific American.]

THE HEATING SURFACE OF BOILERS.

The questions sent to us in regard to boilers continue to multiply, and we imagine that we have received inquiries on all the points connected with the subject. We propose, therefore, to devote some space to answering these questions more in detail than is possible in our correspondence column; and after disposing of the topic indicated by the title of this article, we will give some directions in regard to setting boilers, proportioning them for engines of given size, etc.

There is some difference of opinion among engineers in regard to what parts of a boiler are to be considered in estimating its heating surface; but in the rules which are appended, the methods most commonly employed are adopted.

(*a*) Cylindrical boilers: These, forming the simplest class of boilers, consist of plain cylinders, sometimes with and sometimes without steam drums. The heating surface of such a boiler is half the surface of the shell, or it is equal to 1·5708 × the diameter of the boiler × the length. It is to be observed that, in this and in the rules that follow, all dimensions are to be taken in feet; so that, in applying the rule, any proportions that are expressed in inches are to be divided by 12, before making the calculation. Thus: Suppose that a given boiler has a diameter of 36 inches and a length of 20 feet: its heating surface is the product of 1·5708, 3, and 20, or about 94¼ square feet.

(*b*) Cylindrical flue boilers: A boiler of this class is a cylinder with two large flues. Its heating surface is half the surface of the shell, increased by the sum of the interior surfaces of the flues, or 1·5708 × diameter of boiler × length + 6·2832 × interior diameter of flues × length.

For the sake of illustrating this rule, suppose that a flue boiler has a diameter of 48 inches or 4 feet, and a length of 22 feet, and that the interior diameter of each flue is 15 inches, or 1¼ feet. Then the heating surface is equal to the product of 1·5708, 4, and 22, or nearly 138¼ square feet, increased by the product of 6·2832, 1·25, and 22, or about 172¾ square feet, making the total heating surface 311 square feet.

(*c*) Cylindrical tubular boilers: As the name implies, these boilers are cylinders containing a number of tubes. To find the heating surface of such a boiler, take half the surface of the shell and add it to the interior surface of the tubes. Expressing this rule in a similar manner to the foregoing, it may be said that the heating surface of a cylindrical tubular boiler is equal to 1·5708 × diameter of boiler × length + 3·1416 × number of tubes × interior diameter of a tube × length.

Example: A cylindrical tubular boiler has a diameter of 42 inches or 3½ feet, is 16 feet long, and contains 40 tubes, each having an interior diameter of 3¾ inches, or 0·323 feet. What is its heating surface?

Answer: The product of 1·5708 × 3·5 × 16 is nearly 88 square feet.

The product of 3·1416 × 40 × 0·323 × 16 is about 649 square feet.

So that the whole heating surface is 737 square feet.

When the dimensions of a tubular boiler are given, the outside diameter of the tubes is usually stated, so that twice the thickness must be subtracted to obtain the diameter to be used in the calculation. The thickness of tubes by different makers varies somewhat, but those given below are average values, and can generally be used without serious error. The table gives dimensions of standard sizes of tubes, as well as a column of heating surface, which will greatly facilitate calculations.

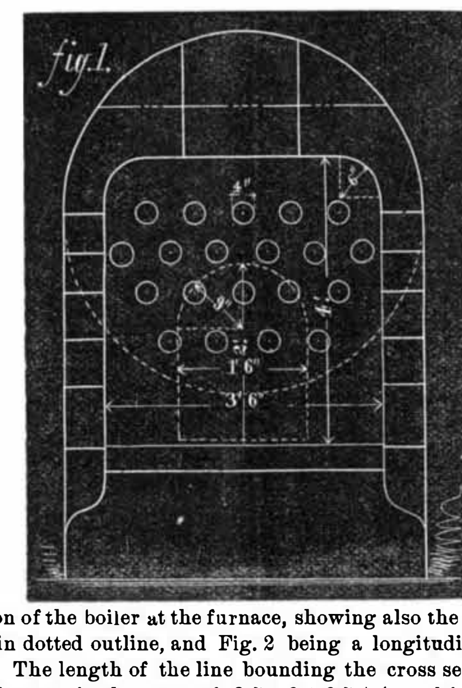
Outside diameter in inches.	Thickness in inches.	Internal diameter in inches.	Internal diameter in feet.	Heating surface in in square feet, per foot of length.
1 25	0·072	1·106	0 0922	0·3273
1 5	0·083	1·334	0·1112	0·3926
1·75	0 095	1·560	0·1300	0·4589
2·	0 095	1·810	0 1508	0 5236
2·25	0·095	2 060	0·1717	0·5890
2·5	0·109	2 282	0·1902	0 6545
2·75	0·109	2 532	0·2110	0·7200
3·	0·109	2·782	0 2318	0·7853
3·25	0 120	3 010	0 2508	0 8508
3·5	0 120	3·260	0·2717	0·9163
3·75	0·120	3·510	0·2925	0·9817
4·	0·134	3·732	0 3110	1·0472
4·5	0·134	4·232	0·3527	1·1790
5·	0·148	4·704	0 3920	1·3680
6·	0·165	5·770	0 4808	1·5708
7·	0·165	6·770	0 5642	1·8326
8·	0·165	7·770	0·6475	2·0944
9·	0·180	8·640	0·7200	2 3562
10·	0·203	9·594	0·7995	2·5347

To illustrate the use of the table, suppose it is required to find the heating surface of the tubes in a boiler which contains 60 tubes, each 3 inches outside diameter and 12 feet long. The total length of tubes in the boiler is 12 times 60, or 720 feet, so that the heating surface is 720 times 0·7853, or about 565 square feet.

(*d*). Locomotive and vertical boilers: In this class, the furnaces are contained within the boilers. The heating surface of such a boiler is all the surface in the furnace increased by the interior surface of the tubes.

Locomotive boilers: The furnaces of boilers of this class do not all have the same form of cross section, so that the rule for determining the heating surface cannot be, generally, expressed precisely in detail. It may be said, however, that the heating surface of a locomotive boiler is equal to the length of the line bounding the cross section of the furnace × the length of the furnace + 2 × the area of the cross section of the furnace — the area of the furnace door — the number of tubes × 0·7854 × (the interior diameter of a tube)^2 + the number of tubes × the length of the tubes × the heating surface of a tube per running foot.

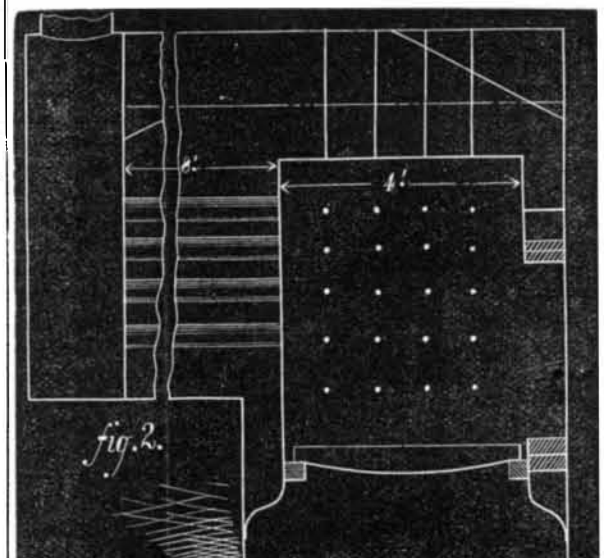
As an example of the use of this rule, suppose it is required to determine the heating surface of a boiler having the dimensions noted in Figs. 1 and 2—Fig. 1 being a cross



section of the boiler at the furnace, showing also the furnace door in dotted outline, and Fig. 2 being a longitudinal section. The length of the line bounding the cross section of the furnace is the sum of 3·5 × 2 + 2·5 + 1 multiplied by 1·5708, or about 11·07 feet. The area of the sides and top of the furnace is 4 times 11·07, or 44·28 square feet. The area of the cross section of the furnace is the sum of the products of 3·5 × 3·5 + 0·5 × 2·5 + 0·5 × 0·7854, or about 13·89 square feet. The cross section of the tubes is the product of 20 × 0·7854 × (0·311)^2, or about 1·52 square feet. The area of the furnace door is the sum of the products of 1·5 × 1·25 + 0·3927 × (1·5)^2, or about 2·76 square feet. The interior surface of the tubes is the product of 20 × 8 × 1·0472, or about 167·55 square feet. Hence the heating surface of the boiler is 44·28 + 2 × 13·89 — 1·52 — 2·76 + 167·55, or about 235½ square feet. This example shows the general method to be employed for locomotive boilers, and the dimensions that are to be taken.

2. Vertical boilers: The furnaces of these boilers are ordinarily cylindrical, so that the rule for the heating surface is as follows: 3·1416 × diameter of furnace × hight of furnace + 0·7854 × (diameter of furnace)^2 — number of tubes × 0·7854 × (interior diameter of a tube)^2 + number of tubes × length of tubes × heating surface of a tube per running foot.

Example: Required the heating surface of a vertical boiler, having the following dimensions: Diameter of furnace, 24 inches, hight of furnace, 18 inches, 40 tubes, each 2 inches outside diameter, 6 feet long. The heating surface is the sum of the products of 3·1416 × 2 × 1·5 + 0·7854 × 2^2 + 40 × 6 × 0·5236 = 138·23, diminished by 40 × 0 7854 × (0·1508)^2 = 0·72, or 137·51 square feet.



These rules might be extended, so as to include sectional and marine boilers, together with some special forms which are occasionally used: but it is believed that they are sufficiently comprehensive to apply to nearly all boilers employed in this country for stationary and portable engines. The simple manner in which they are expressed, and the illustrative examples accompanying them, will doubtless be appreciated by the reader.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The meeting this year is a light one in point of attendance; but the lack in this respect is in a measure compensated for by the absence of ponderously technical papers and the substitution of essays having a more practical bearing upon the scientific questions of the day. While a cardinal object of this association is the interchange of ideas of all kinds among its learned members, the nature of such interchanges should, we think, be subordinated to considerations of public instruction and benefit, and hence dissertations on abstruse points and technicalities unintelligible to all save those versed in the particular branch of Science involved, might well be reserved for dissemination through narrower channels, leaving a clear field for the discussion of subjects within the general public comprehension. It is impossible to publish such papers in their entirety, and equally impossible to prepare fairly intelligible abstracts. We give below a *resumé* of the essays thus far read.

Professor Lovering described an acoustic method of measuring the velocity of electricity. He stated that a wire from Cambridge to San Francisco, thence back through Canada to Massachusetts, about 7,200 miles in all, transmitted a message in two thirds of a second, and that some of this time was wasted through thirteen repeaters. The system proposed consisted in utilizing the vibrations of tuning forks, which may indicate intervals of one ten-thousandth of a second, or even less.

Professor Farquharson read an account of recent

EXPLORATIONS AMONG INDIAN MOUNDS,

which resulted in the discovery of thirty skeletons, several copper implements, and a pulley or spindle wheel of terra cotta. In one skeleton two of the neck bones were found anchylosed, giving evidence of a disease rare at the present time among adults, and from which they only survive by very careful treatment.

Professor E. B. Andrews compared the Ohio and Virginia sides of

THE GREAT ALLEGHANY COAL FIELD.

On the Kanawha there are 3,100 feet of productive coal measures below the horizon of the Pittsburgh coal. The remarkable belt of coal seams found on the Kanawha, between Charleston and Kanawha, on Coal river, on the Guyandotte, and on the upper waters of the Twelve Pole, and on the Tag and Louisa forks of the Big Sandy, is the finest belt of bituminous coal in the United States. The professor traced the probable direction of the great West Virginia geosynclinal trough, and expressed the opinion that it had a connection with the ancient ocean to the southwest by the way of Tennessee.

Professor J. S. Newberry gave descriptions of some newly discovered

ANCIENT FISHES

found in the Devonian and carboniferous rocks of Ohio Among these was the entirebony structure of the *dinichthys Terellii*, the hugest of all the old armor-plated ganoids. The dorsal shield weighed 30 pounds. Drawings of another species of *dinichthys* were shown, in which the maxillaries and mandibles were set with teeth instead of being sharp-edged. Professor Newberry explained that the *dipnoans* of Africa and South America, the *lepidosiren* and *protopterus*, were descended from these ancient plated ganoids, and were the last remnants of a group of fishes which in the Devonian age not