TRANSACTIONS

OF THE

DUDLEY AND MIDLAND

GEOLOGICAL & SCIENTIFIC SOCIETY,

AND FIELD CLUB.

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A Committee Meeting was held on Tuesday, November 1st, 1864. Present, Messrs. E. F. Smith, (Chair,) H. Beckett, E. Hollier, H. Johnson, H. Burton, C. Ketley, J. Stokes, and the Secretary.

J. Cope, Albrighton, was elected a Field Club Member.

As a very interesting section of Thick Coal was exposed in open workings, at the Earl of Dudley's Clay-cross Collieries, a Meeting of Ordinary Members was held at the place, on Tuesday, November 1st, 1864. Having examined the peculiar geological features of the section, the Members adjourned to the Society's Rooms, when Mr. Hy. Beckett, F.G.S., delivered the following, being the second of his series of Lectures on

"THE SOUTH STAFFORDSHIRE COAL FIELD."

In my former paper the description of the various formations which constitute the Crust of the Earth, as exemplified in Great Britain, was necessarily brief; as being simply an introductory outline of typical stratification which may be studied in the widely spread regions of our wondrous globe, with more or less intricacy of detail. Isolated stratification may vary in particular spots, the ruling features are however fully established; and I will venture to assure you, that you may, if convenient, place me, or any one who has well considered the subject and acquired a fair degree of Lithological and Palæontological knowledge, in any one of the great divisions of the earth;—give but a hammer or a Miner's pick-axe, a clinometer, a pocket meridional compass, a few test bottles, and a well exposed surface, and in a short period of time, we should, most probably, be able to furnish you with a key to the geology of the district, however extensive. Now, you will naturally ask,—how these things can be? How have the various assemblages of rocks been gathered together;

and whence their origin? No sane man can for a moment doubt the ruling Power which governs the whole; but like questions were propounded ages ago,—and, I will tell you how, in the infancy of science, an embryo philosopher answered them. "The earth," he said, "was originally part and parcel of a more glorious luminary,—the Sun; which vivifies nature and governs the lesser orbs of Heaven in a systematic but delightful manner. It so happened," said Mr. Sagacity, "that once upon a time, a wild and dissipated comet was thoughtlessly frisking about, with a disposition 'Ultra finem tendere opus,' as Horace has it, (to launch beyond all bounds) when, in an unlucky moment, it had, what mischievous boys call 'a shy' at King Sol,—separating a huge fragment; which, being set a spinning by the force of ejection, whirl'd off, as mad as a March hare; and it was only after repeated blows from the Great Bear and divers other heavenly bodies, with which (not being akin to the artful dodger) it came in contact, that it was rounded into shape and finally obtained fixation. The newly made earth, as Historians *tell us*, then coolly settled down and arranged its solvent parts,—the heaviest, of course sinking by gravitation (don't let this disturb *your* gravity,) like the plums in a badly cooked pudding, and the rest followed as they best could!"

I think you will agree with me, that this ill-digested theory will not pass muster. I really cannot for a moment fancy that the Earth ever formed part of the Sun, or was entitled to be called *Sun-in-law;* and, moreover, this erratic mode of settling its differences or accumlated particles, does not quite satisfactorily account for certain phenomena which have been detailed, such as finding rocks sometimes perfectly flat, elsewhere reared upon their edges, as beautifully exhibited at Dudley Castle and the Wren's Nest. I forbear relating numerous other theories, which puzzled earlier Cosmogonists, and are equally crude and incredible.

The first writer who appears to have entertained sound views of the causes which have been in operation during the formation of the Earth, was Strabo, who flourished in the commencement of the Christian era. After criticising various earlier theories, Strabo summed up thus,—"It is not because the lands covered by seas were originally at different altitudes, that the waters have risen or subsided, or receded from some parts and inundated others. But, the reason is, that the same land is sometimes raised up and sometimes depressed, and the sea also is simultaneously raised and depressed; so that it either overflows or returns into its own place again. We must therefore ascribe the cause to the ground,—either to that which is under the sea, or to that which becomes flooded by it; but rather to that which lies beneath the sea, for this is more moveable, and, on account of its humidity can be altered with greater celerity. It is proper," he adds, "to derive our explanations from things which are obvious, and in some measure of daily occurrence; such as deluges, earthquakes, and volcanic eruptions, and sudden

swellings of the land beneath the sea; for the last raise up the sea also; and, when the same lands subside again they occasion the sea to be let down. And it is not merely the small, but large islands also, and, not merely the islands, but the continents, which can be lifted up together with the sea; and both large and small tracts may subside; for habitations and cities, like Buré, Bizona, and many others have been engulphed by earthquakes." In another passage, this learned Geographer, in alluding to a received tradition that Sicily had been separated by a convulsion from the mainland of Italy, remarks, that "At present, the land near the sea in those parts is rarely shaken by earthquakes, since there are open orifices whereby fire and ignited matters and waters escape: but, formerly, when the volcanoes of Etna, the Lipari Islands, Ischia, and others were closed up, the imprisoned fire and wind might have produced far more vehement movements." The doctrine, therefore, that volcanoes are safety valves; and, that the subterraneous or subaqueous convulsions are probably most violent when first the volcanic energy shifts itself to a new quarter is not modern.

Geologists of the present day have merely amplified these theories, so far as relates to physical cosmogony; but they take a surer path than mere theorising; leaving such trifling speculations to absurd scribblers they are content to examine and record facts;—to be the stone breakers and Mc Adamisers of our noble science: and, so long as this course is prudently pursued, we may calculate, with reasonable certainty, that the accumulation of practical scientific observations, will tend toward a final successful result.

Without however attempting to trench on what may be termed debateable ground, I may be allowed to observe, that both sedimentary and igneous actions are traceable in the conformation of the Earth. South Staffordshire affords ample proofs of such agencies, and perhaps few districts offer more direct and interesting illustrations of the great and systematic changes thus caused in the ancient form of the earth, which have wrought such blessings in our midst.

"By the Word of God, the heavens were of old and the earth standing out of the water and in the water; whereby the world that then was, being overflowed with water perished: but the heavens and the earth, which are now, by the same Word are kept in store, reserved unto fire against the day of judgement."—2 St. Peter, chap. 3, v. 5, 6, 7.

Again in the 104th Psalm,—"The waters stood above the mountains; at Thy rebuke they fled; at the voice of Thy thunder they hasted away. They go up by the mountains; they go down by the valleys, unto the place which Thou hast founded for them. Thou hast set a bound, that they may not pass over; that they turn not again to cover the earth." "O Lord! how manifold are Thy works! in wisdom hast Thou made them all; the earth is full of Thy riches."

The language of the Holy Scripture, as is common with Oriental descriptions, is often figurative; but except in the case of evident miracles, which the true Christian will never presume to question; you may rely on it, exact science, guided by the modest and distrustful spirit which distinguished the immortal Newton will never really be antagonistic thereto. In all speculations, however, connected with the present configuration of our favoured planet, I must caution you against contrasting modern visible agencies with the overwhelming force which must have prevailed in remote times, or the finite with the infinite.

In examining the sublime passage I have just quoted from the Psalms of David, science renders it intelligible to the meanest capacity. Thus, "The waters stood above the mountains."—In rendering this extract, it is not necessary to conclude that the surface of the earth was entirely deluged; the fiat of the Almighty may possibly have been confined to the habitable portion, which would reconcile the querulous objections to the olive leaf plucked off by Noah's feathered messenger. But, however this may have been, if we ascend the summits of some of our highest inland mountains;—take Snowdonia for example, we shall find abundance of marine shells interstratified, and "cemented together by some *lapidescent juice*," as Dr. Plot, the first Natural Historian of our County quaintly terms it, in contra-distinction to the "petrifying juice" which he finds it convenient to apply to certain "Flores arborescentes internodus distincti." The learned Doctor,

> "Whose searching *Genius*, like the *Lamp* of day
> Did the Earth's furniture display,
> Nor suffer'd to lie buri'd and unknown
> *Nature's* rich *talent* or his *own*."

admits the existence of Toads and Evets or Newts in Stones and Trees; because, as he says at page 250 of his amusing history,—"I doe not conceive them wholly deprived (tho' so close prisoners) either of *Air* or *Aliment*: for the *cavities* they are lodg'd in are generally somewhat bigger than *themselves*, and they have the *Salts* of the *Stones*, and *Juices* of the *Trees*, to suck and lick; which, together with the transcolation of such *fine dews* which, as De Laït thinks, the rocks imbibe and transmit, may very well support an *Animal* of so slender a dyet; that no ways spends itself in *perspiration*; and is absolutely shut up from all other *expense* of its *juices* or *spirits*, in *swimming*, *travelling*, *generation*, or otherwise,"—yet he denies the veritability of all our beautiful fossils, (which he terms "Formed Stones,") because, forsooth, they are "so altogether unlike any of the living *Shell-fish*, that alone, they are sufficient to convince any unprejudiced person, that all these *formed stones*, cannot be shaped in *Animal moulds*." The very abundance of the fossil shells, appears to aid the Doctor's argument; "so little," adds he "seems *Nature* to have needed *Animal Moulds* for these productions."

I presume it is unnecessary at the present day to combat Dr. Plot's peculiar arguments; the facts are undeniable: but whence the change, in the relative position of land and water? Can any thing be more clear than the context? "At Thy rebuke they" (the waters) "fled; at the voice of Thy thunder," which, without overstraining, we may accept as volcanic eruptions and attendant earthquakes, "they hasted away, they go up by the mountains; they go down by the valleys," (literally the mountains ascend, the valleys descend) "unto the place which Thou hast founded for them."

All thoughtful philosophers are agreed in the opinion, that the major portion of the earth's crust,—certainly its visible portion is sedimentary; i.e. derived from the abrasion or wearing away of older rocks (a circumstance of like daily occurrence). The abraded masses, or accumulated particles, have successively been deposited in a stratified manner,—that is layer upon layer, like a pile of books, by the action of moving waters, either marine or derived by rivers, &c., from the mainland; the former vastly preponderating, as evidenced by the widely spread organic relics. We have no authority or reasonable grounds for supposing that the earth ever held within its bounds more considerable volumes of water than now charge her oceans, seas, lakes, and tributary streams, the changes of level in the land and unconformity of stratification, must therefore necessarily have been caused by upheavings and depressions of the *terra infirma*, for the balance in land and water exhibit the utmost perfection.

"God stood and measured the earth; He beheld and drove asunder the nations; and the everlasting mountains were scattered, the perpetual hills did bow: His ways are everlasting.

I saw the tents of Cushan in affliction; and the curtains of the land of Midian did tremble.

Was the Lord displeased against the rivers? Was Thine anger against the rivers? Was Thy wrath against the sea, that Thou didst ride upon Thine horses and Thy chariots of salvation?

Thy bow was made quite naked, according to the oaths of the tribes,—even Thy Word. Selah! Thou didst cleave the earth with rivers.

The mountains saw Thee and they trembled: the overflowing of the water passed by: the deep uttered his voice, and lifted up his hands on high." Habakkuk, c. 3.

This subject alone would fill volumes, but I must pass on to other themes, viz.: the consideration as to the formation of Coal and Ironstone, with their associated strata. What is Coal? All know its application and multitudinous uses. In South Staffordshire, I regret to say, we know something also of its abuses; but, did you ever inquire into the origin of this invaluable mineral, or how it was produced? Some among you may probably answer me as a man at Coseley did one day. I was examining his garden wall, constructed

of queer, yellowish looking, concretionary fragments of rock, derived from what are termed coal measures, and with which you are doubtless familiar,—the Cone in Cone or Kyrle-stone as it is sometimes called; a crystallized and hard ferruginous mineral,—very abundant in some districts: and I was desirous to obtain his opinion of it as a practical miner; for there is no man, however humble, but you may learn something from him. I never despise the judgment of a *sober* workman; a *drunken* one exhibits his lack of judgment by his selfish and reckless abandonment of character and christian duty; and, tho' he may be clever, he is seldom to be relied upon. "These stones are very curious," I said, "I wonder how they were formed?" "Why," he replied "I reckon they'm as God Almighty made 'em." An excellent and thoughtful answer, betokening Sabbath instruction; and many would think a slight rebuke for meddling with things beyond my comprehension. I do not, however, propose to lessen your views with regard to the power and goodness of God in the creation; but, on the contrary, hope to demonstrate that His beneficence and wisdom always become more conspicious, the more minutely we examine His works in a humble and devout spirit; for we then convince ourselves, (if it were possible we could previously have doubted) that they are all designedly good and perfect. How intensely interesting are thoughts like these to the scientific observer!

Sir Humphrey Davy, the Colliers' friend, has informed us, that "Coal" which, by the way, like many of our mining terms is of Saxon or Teutonic derivation, "is a bituminous substance, to the composition of which both the mineral and animal kingdoms seem to concur. This most useful mineral appears to consist chiefly of vegetable matter, mixed with the remains of marine animals and marine salts; and occasionally containing a quantity of sulphuret of iron. Thus it is," he adds, "that we find the earthy, the metallic, and the saline parts of coal, which compose the cinders, or fixed products of their combustion; while the hydrogen and carbon, which they derive from vegetables, constitute their volatile products."

It may be interesting to compare analyses of a few carbonaceous substances somewhat allied to coal in composition; I therefore extract the following series from Bischoff, vol. 1., c. 15:

	Carbon.	Hydrogen.	Oxygen & Nitrogen.	Earthy substances or Ash. minimum.		maximum.
Wood	49.1	6.3	44.6	—		—
Peat	54.1	5.6	40.1	4.6	to	10.
Lignite	69.3	6.6	25.3	.8	to	47.2
Coal	82.1	5.5	12.4	.24	to	35.5
Anthracite	95.	3.92	3.45	.94	to	7.07

Such are the mean results of several analyses of peat, lignite, and coal. The extreme appears to have been selected for Anthracite, in order to contrast it

with Wood, which exhibits the extreme in another direction. It will be evident that a regular gradation appears to exist from anthracite and bituminous coal, through lignite and peat into wood; which certainly favours a vegetable structure throughout; and, in support of this hypothesis, two eminent naturalists, Messrs. Lindley and Hutton, the authors of "Fossil Flora," have advanced a step further; and, on the authority of Mr. Witham, have been enabled to identify the structure of Coal forming plants. "Pieces of compact Coal," they assert, "have been reduced to a transparent state; or sufficiently near thereto to be examined microscopically;—the results of which are, that wood, still preserving its texture, exists in a mineral state extensively throughout our coal beds." They also further observe, that, "in most cases, it has a structure somewhat analogous to, though not altogether agreeing with recent Coniferous wood; and, that when Coniferous, the fibre is totally different from any modern trees."

To a certain extent, I am fully prepared to admit these general observations; though my experience induces me to consider the bulk of coal forming plants to have been of Crytpogamic or Acrogenous and Endogenous origin, rather than belonging to the higher order of the Exogens or wood forming genera. With numerous plants of those orders, the young stems being of a somewhat succulent nature, would, by maceration, commonly lose all structural character;—though the bark, and, in some cases cylindrical trunks, being tougher and more compact,—especially in the more mature specimens, would naturally retain their ancient texture, but become mineralised. The proofs of vegetable origin of Coal are not confined to questionable experiments. We have ample confirmation of the assumption from faithful impressions of bark, to which I just alluded: and in some coals especially, the thin partings are matted masses of pure carbon (the velvet of the Colliers), retaining the reedy character of the preponderating plants from which they have been derived. The attendant beds of Argillaceous Ironstone, Sandstone, Fireclay, and Shale, also contain innumerable fragments of Ferns of exquisite beauty and perfection, which are certainly not derived from what Dr. Plot is pleased to term "A plastic virtue latent in the earth." Brongniart informs us that "in the great Coal formation, 120 known species of Ferns have been discovered, constituting nearly one half of the Flora of that period. These species," he adds, "represent but a small number of the forms which occur among living Filices; and nearly all belong to the tribe of Polypodiaceæ, in which tribe we find the greater number of existing arborescent species. Indeed, fragments of the stems of arborescent Ferns occur occasionally in the same formation." M. Brongniart considers these circumstances as indicating a vegetation analagous to that of the Islands in the equinoctial regions of the present earth; and infers that the same conditions of heat and moisture which favour the existing vegetation of these Islands, prevailed in a still

higher degree during the Carboniferous era. Of other Coal forming plants the Lepidodendron resembles the Lycopodiaceæ, or Club Moss Tribe; but may probably have formed a class intermediate between Lycopodiaceæ and Coniferæ. Calamites were evidently allied to Equisetaceæ. Sigillariæ with Stigmarian roots appear to have been Dicotyledenous plants, distinct from Ferns, and differing from any recent vegetation; though somewhat approaching Cacteæ and Euphorbiæ. The Favularia, Bothiodendron, Ulodendron, and Megaphyton, are classed with Sigillariæ. The remains of true Coniferæ are rare in the Coal formations of the Carboniferous epoch; they occur more frequently in the Secondary, but are most numerous in the Tertiary formations. The difficulty in identifying Coniferæ, in the Carboniferous rocks, arises from the fact that the specimens exhibit imperfect representations of the concentric rings, by which the annual layers of wood are separated. This is also frequently the case with the trees of our modern tropical regions; which seems to indicate, that, in both cases, the change of seasons,—so far, at least, as regards temperature, were scarcely perceptible.

The South Staffordshire district has afforded strong evidence in support of the vegetable origin of Coal; especially by the fossilized trees laid bare in the Bottom Coal open-work in the Parkfields' Colliery, which I had the pleasure of introducing to the scientific world a few years ago.* The stumps of these remarkable trees were nearly all upright,—in perfect preservation; and they occupied the spots were they anciently grew, though their entire substance was converted into Coal, more or less pure; and sometimes exhibiting a most brilliant disc-like arrangement of constituent particles, probably resulting from the peculiar action of pent-up gases. Thus, we had the outer bark imperfectly developed, with the cylindrical stems, erased to the level of the Coal seam. The interior of each tree was a matted mass of carbonaceous matters, consisting evidently of macerated leaves and stalks of plants, confusedly mixed with ancient mud. The fossilized trunks were in great abundance, upwards of eighty trees being visible on the top Coal bared within an area of a quarter of an acre; some of them being a yard in diameter, and tranquilly embedded in a regular Coal seam, composed without doubt of the leaves and more delicate portions of the trees, interspersed with prostrated flattened trunks. It is worthy of remark, that this ancient forest was not confined to a single seam or layer of Coal; for, on removing the upper Coal and a few inches of Fireclay parting, another and still more perfect forest was developed; and, so again, with the lowest portion of the coal, (the entire thickness being 12 feet,) and all the three forests were of different ages. The character of these Coal forming trees was deciphered in the Fireclay partings, these being evidently the soil on which they grew, and which appeared well adapted for the purpose. Thus, we found the Lepidodendron, Ulodendron,

* Journal of the Geological Society. Vol. 1, Part 1.

Calamites, Sigillaria with its Stigmarian roots and elongated rootlets,—some elegant, and, I think, undescribed flowers and fronds, together with imperfectly developed plants, in which structural character had been destroyed; and which could not therefore be identified.

Of animal remains I found a few shells of the genus Anthracosia, and scales or armour-like plates of the Megalicthys,—a great fish. My lamented friend Dr. Ick, who visited the locality with the late Dean Buckland and Mr. Vernon Harcourt, subsequently discovered teeth and dorsal spines of fish with Coprolites or exuviæ of those ancient inhabitants of what were probably brackish waters studded with a marshy archiæpelago. The views I promulgated with regard to the Parkfield's forests, in a communication made to the London Geological Society were opposed to pre-existing ideas; I was, however, fortunate enough, shortly afterwards to meet with fine erect trees of like character, yet more perfect, but differently mineralized, in the road cutting at Woodsetton, also others at Lower Gornal, which fully supported my expressed notions. A noble tree in the New Mine Coal at Darlaston Green was another familiar illustration. This prostrate tree was fully fifty feet long; and the articulations for branches were widely different to those of the Abietinæ or even Palms, which, by some Geologists have been considered Coal forming, and connected with Carboniferous period:—a fact which I cannot admit, with regard at least to the former. The Coal beds themselves are not the best store-houses for perfect fossils. A peculiar decomposition appears to have taken place during the Coal formation, assisted by a certain degree of caloric generated by that process, or otherwise communicated. This, to some extent, would doubtless be fatal to structural preservation, especially when assisted by liberated gases. If, however, you place a few leaves in a ball of Fireclay, and expose it to certain conditions of artificial heat, you will find the leaves converted into Coal, preserving the most delicate forms of the original plant, and admirably illustrating the innumerable impressions in the Coal seats and roofs. Shales are favourable to such preservation; rocks, from their irregular and open composition far less so: but the most perfect illustrations I have met with are among the Argillaceous Ironstones. I remember one specimen of Ironstone, in particular, which I forwarded to the National Museum in Jermyn Street; in this the external bark, though reduced by attrition, was yet tolerably perfect, proving it to be a Lepidodendron; within, however, no structural character of the original plant was discernible. The pulpy substance had been replaced by aluminous matter, charged with forty per cent. of Carbonate of Iron; and, disseminated through this foreign mineral, I found upwards of thirty fossilized fruits or cones, which probably belonged to the original tree, and having the capsules exquisitely perfect. To show you how apparently trifling things may, in scientific hands become important, let me explain to you, that, among other matters

occupying the interior of my specimen, was a small fragment of the outer bark from another portion of the same tree, uninjured by friction, and therefore so admirably perfect, that a distinguished Naturalist, Dr. Hooker, to whom it was submitted, was enabled to read the nature and habits of the plant by the remains so wonderfully preserved. In such cases, it will be evident that the preponderance of Silica, Alumina, or other matrix overwhelms the carbonaceous character of the fossils. "The principal constituent of Coal is Carbon; and this substance" observes Professor Liebig (a very ableChemist,) would be derived from the atmosphere in the shape of Carbonic Acid (the choke damp of the pits) in which state it was assimilated by the plants which constitute the Coal formation. It follows from this, that the atmosphere must be richer in Oxygen, at the present time, than in former periods of the Earth's history; the increase must indeed be exactly proportionable to the amount of Carbon and Hydrogen contained in these Carboniferous deposits. In former ages, therefore, the atmosphere must have contained less Oxygen, but a much larger proportion of Carbonic Acid than now, a circumstance which accounts for the thickness and luxuriance of the earlier vegetations. But a period must have arrived, in which the quantity of Carbonic Acid contained in the air, experienced neither increase or dimunition in very appreciable quantity; for if it received an additional quantity to its usual proportion, an increased vegetation would be the natural consequence, and the excess would be speedily removed; and, on the other hand, if the Gas were less than the normal quantity, the progress of vegetation would be retarded, and the proportion would soon attain its proper standard."

"In former periods of the Earth's history, its surface was covered with plants, the remains of which are still found in the Coal formations." (I am quoting Leibig, remember.) "These plants,—the gigantic Monocotyledons, ferns, palms, and reeds, belong to a class to which Nature has given the power, by means of an immense extension of leaves, to dispense with nourishment from the soil. They resemble, in this respect, the plants which we raise from bulbs and tubers, and which live, while young, on the substances contained in their seed, and thus require no aid from the soil, when the exterior organs of nutrition are formed. This class of plants, is, even at present ranked among those which do not exhaust the soil. The necessity for the existence of such plants, at the dawn of vegetation, must be apparent. The earthy substance which forms the usual nourishment of plants, is a product of the decay of vegetable matter, and therefore could not have existed to supply the first plants with the food necessary for the development of the more delicate kinds; hence, the plants capable of flourishing under such circumstances, could only be those which received their nourishment from the air alone. By their decay, however, the soil in which they grew, became supplied with vegetable matter; and the progress of vegetation must have

furnished the earth with materials adapted to the development of those plants which depend on the nutriment contained in the soil, until those organs are formed which are destined for the assumption of nourishment from the atmosphere."

The venerable and illustrious Humboldt, in kindred spirit remarked, "It is this great fact which lends to my mind, a chance for the science of Geology. The thought, that, the Oxygen, as Carbonic Acid, was emitted so plentifully in the volcanic disturbances of the ancient world,—which formed part of its atmosphere,—then passed into the composition of the flora of the gigantic vegetation of the present Coal-fields; the liberated Oxygen in after ages uniting itself perhaps with a mineral forming a Sulphate, again to be reduced by organic matter to a Sulphide; the Carbonic Acid freed again, passing off into Oxygen by the vegetation of the Oolitic period, taken up into the systems of the Icthyosauri; that this same Oxygen (for what we know to the contrary) may, even now, be helping to carry on in *us* the vital process;—is still at work, to change again,—to become as pure and liberal as it ever was, and, not different from ourselves; never to wear out or decay, but, while the world lasts, to be pursuing a destiny pre-determined before its existence by the Great Author of nature."

It is a somewhat remarkable coincidence, which is akin to the subject, that Lignite, as well as Mineral Coals are invariably accompanied by Iron Pyrites and Zinc Blende (the Sulphides of Iron and Zinc,) and, these familiar minerals, it is well ascertained, are still formed from salts of Sulphuric Acid with Iron and Zinc, during the decomposition of all accumulated vegetation.

In most Coal-fields there are these varieties of mineral varying however, in their relative proportions in different localities;—viz. Caking Coal, Slate Coal, and Cannel Coal. In each of these varieties, we are enabled, by the aid of the Microscope to discern that, in addition to the fine yet distinct reticulation of the original vegetable texture, they display other cells, containing a light wine-yellow coloured matter of a bituminous nature, but so volatile, as to be entirely expelled by the application of heat, before any material change takes place in the structural constituents of the mass. The number and appearance of these cells naturally varies with the coal-producing plants. Thus, in Caking Coals, the cells are comparatively few, but highly elongated; and it is obvious that in the finest or purest portions of such Coals, where the crystalized structure, as indicated by the rhombic form of its fragments, is best developed, the cellular characteristic is more or less completely obliterated.

In the Slaty or laminated Coal, we find two sets of cells, both of which contain yellow bituminous matter. One group is analagous with those observed in the Caking Coal; the other set constitutes groups of cells of more minute character, and of a somewhat elongated circular figure.

Again, in the varieties known as Cannel, Parrot, and Splent Coal, the crystalline structure, which distinguishes the Caking Coals, is altogether absent, the first kind of cells are seldom traceable; on the contrary, the entire surface is composed of an almost uniform series of the second class of cells observable in Slaty Coal separated from each other by the most delicate fibrous divisions, and filled with bituminous matter which is sometimes of considerable purity. These cells are probably derived from the small web-like texture of the original plants, rounded and contorted by the vast pressure to which the vegetable accumulations have been subjected. I think it probable that some Coals as well as the more oleaginous attendant shales contain large proportions of animal oils, in addition to the vegetable constituents.

In concluding these remarks on the nature and origin of Coal, I may add, that, though the crystalline and imperfectly developed varieties of the mineral, usually occur in distinct strata, it is nevertheless not uncommon to find both kinds in close proximity. This leads me to suppose that the constitutional differences are in a great measure attributable to original diversities in the plants from which they have been derived; and, this opinion is strengthened by the exact similarity of location which they occupy amid associated strata. A more or less tranquil period of deposit would also materially affect the purity of all Coals, increasing or diminishing the amount of ashes, derived from the earthy matters.

Associated with our Coal seams are certain accumulations of Argillaceous Ironstone or earthy Carbonate of Iron, of variable thickness. These mineral deposits are usually found in continuous and tolerably regular congregated flat bands, separated by Shale or Slate Clay; but the Ironstone sometimes occurs in small nodular or reniform masses, or in immense balls; which exhibit a considerable admixture of Carbonate of Lime, and thus form Septaria. Occasionally Galena and Blende,—the Sulphides of Lead and Zinc, together with Sulphides of Iron, Manganese, and Copper occur sparingly in the chambers. The usual proportion of metallic Iron obtained from our local South Staffordshire ores varies from thirty to forty per cent. The mean result of twenty-five analyses made under the direction of Dr. Percy was 35.4 per cent. of metallic Iron.

An inexperienced stranger looking at the mineral when brought out of our pits would be little disposed to imagine, that, from so rough and earthy looking a substance, could be extracted a metal of such universal application; and infinitely more important in point of utility than the gold mines of California and Australia, or the Brilliants of Golconda: yet such is the case.

The theory of the formation of Clay Ironstone is attended with some difficulty; not that we are at a loss for the origin of the Iron or its combinations: but the obstacles are occasioned by the peculiar disposition of the products. When the British Association for the advancement of Science

visited Dudley a few years ago,—"The cargo of Philosophers," as they were facetiously styled, whilst boating along the Canal, to the Tip of the Ton, Dr. Buckland gave an interesting sketch of the locality, beneath the vast arches of the Limestone Caverns. All went on very well, till the learned Doctor had explained his theory for the Ironstone formations; when an old Ground Bailiff of Lord Ward nudged me with his elbow and slyly said, "I'll tell you what Mr. Beckett, that wunna do!" If Dr. Buckland, the great authority of the day, failed to satisfy my old friend, I fear my ideas will add little to his enlightenment if he be now in the land of the living.

During the construction of the Bentley Branch Canal, I noticed an instance of the simple deposition of Iron by gravitation. This was afforded by a section of a small pool near Little London; which, though of trifling extent, displayed a principle, as evident, as though it had been a mare magnum. The bed of the pool was entirely composed of decayed Sphagnum and other vegetable matter,—in fact an embryo Peat bog, about a yard thick. Below this was a distinct layer of Iron, an eighth of an inch thick, in the form of a Hydrated Oxide; and retained in a compact state by an impervious substratum of clay. If instead of clay the substratum had been sand, or gravel, the soluble Iron would have cemented it into a siliceous Ironstone, or a ferruginous conglomerate. As it was, it possessed the characteristic of Bog Iron Ore; whose constituents yield about 66 per cent of Oxide of Iron, 1½ of Oxide of Manganese, 8 per cent. of Phosphoric Acid (a fatal mixture) and water 23. I have often observed the same phenomena, on a larger scale, in Irish Peat Bogs; where it is not unusual to find recent freshwater shells embodied in the embryo Ironstone, just as we have the Anthracosia and other shells of bye-gone ages bedded in the Coal measure Ironstones.

A similar deposition took place at Powk Hill, at the time the mines were being worked by the late Earl of Lichfield, in Bentley Estate; and to such an extent, that, I was informed by Mr. George, his Lordship's Agent, it was necessary to scour out the outlet ditch from the Engine Pit every year, to prevent it being choked up with ferruginous mud. The deposit, in this instance, was derived from the water pumped out of the mines, which held large quantities of Oxide of Iron in solution, resulting in a great measure from the decomposition of the intrusive Basalt adjacent, which forms one of the most interesting objects in the district: in fact it is unequalled in great Britain. Another instance occurs to me. I have for many years acted as Mineral Adviser to Sir Stephen R. Glynne, and many other parties in North Wales. I well remember the time, when the Mill Pool, near Hawarden Park, was perfectly clear and pellucid; a small stream passing through it, and feeding some ornamental waters below. On opening extensive Collieries in the neighbourhood, a considerable body of water, highly charged with Iron passed through the pool, which has gradually silted up with Iron mud. The brook

has now merely a small channel through the centre of the mere: and its entire course is strongly marked with the pervading mineral. Moreover several small ponds in the Park are in the same condition as the Mill Pond; and doubtless contain imbedded fish remains. I am impressed with the belief, that many of our stores or pockets of Hæmatite, with their connecting ferruginous strings or leaders, were formed in like manner, by simple deposition; but perfected by subsequent geological changes, rendering them air-tight under pressure.

We have thus two sources, from whence Iron Ores may have been derived,—vegetable and mineral, the latter doubtless preponderating. There is a difference between the formation of Ironstone Beds or measures and Mineral Veins; and therefore we must be careful not to attempt to apply a common theory for their explication. Ironstone beds are formed by segregation; that is, the particles of Iron contained in a given body,—as water, for instance, are separated from the gross mass, either by their subsidence, induced by greater specific gravity, or by a well understood chemical affinity; whilst Mineral Veins are generally considered to have been largely produced by the agency of heat combined with electricity.

Iron is one of the most extensively disseminated minerals known. Scarcely any substance can be named, with which it does not enter into combination. Water, the universal solvent (and, hence the prudent Man's beverage) is rarely free from Iron, which confers the Chalybeate property. It is found in all the rocks, igneous as well as sedimentary; it plays an important part in the animal kingdom, and in the vegetable world, as I have shown it is most abundant. Instances occur, in various parts of Great Britain, where accumulations of Ironstone occur, upwards of 16 feet in thickness, and extending over large areas. In North America, even these enormous and valuable deposits are greatly exceeded. There is no difficulty, therefore, in the assumption, that the immense assemblages of Vegetable matter, from whence our Coal seams have been derived, would afford ferruginous supplies, in sufficient bulk to aid materially, though by no means exclusively, in contributing to the Ironstone beds associated therewith; independently of considerable amounts of the same mineral, absorbed in variable proportions in other strata comprised in the Coal-fields. This fact admitted, we can also readily conceive, that a segregation of Iron took place during the Coal-forming period; and, it is highly probable, the subtle process would be facilitated by Galvanic action.

Professor Wheatstone observes, that "Where two bodies,—one of which is liquid, re-act very feebly upon each other, the presence of a third body, which is either a conductor of Electricity, or, in which capillary action supplies the place of conductibility, opens a path to the Electricity resulting from chemical action; and a Voltaic current is formed, which serves to augment

the energy of the two bodies." Some among you are doubtless familiar with what are styled Electrotypes. Now, the process by which those elegant and faithful transmutations are accomplished, is much like what I consider must have been in action, on a gigantic scale, to produce Ironstone; and, it is based on the simple law that, when any metallic solution is subjected to the direct action of the Voltaic current, the metal itself will be educed; although not always in the same state. We may thus understand how a band of Ironstone may, during the mysterious agency of nature, have been elaborated; but in our Coal-fields the Ironstone is occasionally met with in the form of balls; and the beds or layers are often congregated together, as in the Parkfield's Colliery,—where I counted twelve continuous bands of stone, besides what are called "Chance Stones," overlying the Bottom Coal; with partings of Shale, from four inches to two feet thick, only, between them. The difficulty with regard to the Balls, or nodules of Ironstone, may be easily removed; as there is no doubt, the beds in which they occur, were originally deposited in continuous layers,—but, before consolidation, re-arranged their constituent particles around a leaf, a branch, or some other nucleus of like character, on the principle of molecular attraction. A remarkable instance of this nature occurs in the Derbyshire Coal-field, where the Bottom Ball Ironstones contain rootlets of Stigmaria and numerous well preserved entire Fishes, usually from four to seven inches long; belonging to the genera Palæoniscus and Platysomus. In describing these interesting remains of a former period, Mr. Warrington Smyth remarks, that "From the fact that the beds close above these Fish nodules exhibit abundant remains of plants, it would appear highly probable, that the Fishes were left in a shallow pool, at low water; or were, by some similar means cut off from escape seaward; and, having thus soon perished, were covered up and entombed in the irony mud which was brought down by fresh water; and which, whilst yet soft, aggregated around their bodies in lenticular nodules."

It is right I should state, that all Coal-fields are not equally favoured with the large extent of Argillaceous Ironstone which has distinguished South and North Staffordshire, Derbyshire, Warwickshire, and Salop. In Lancashire, Durham, and the vicinity of Newcastle-upon-Tyne for instance, these ores are not usually abundant; though the Pontop district in Northumberland affords a notable exception to the rule. In France also, their presence is exceptional, in the Coal measures; as in the Aveyron basin, in which the flourishing Ironworks of Decazeville are situated, which abounds with the mineral. Where absent there may have been a lack of concentration, owing to the want of alternate permeability and repulsion, in the associated strata; whereby the Iron is more widely and indiscriminately diffused.

With respect to the numerous bands of Ironstone occurring in such close proximity, we may assume that, in the majority of cases, Coal was

undoubtedly derived from local vegetation; as in the Parkfield's Colliery, and which possibly occupied low Islands in Estuaries, or amid the deltas of vast tidal rivers, and subject to repeated swampages from the adjacent continent. Such irregularly dispersed islands would be originally clotted over the watery space by protrusions, resulting from the ancient contemporaneous elevation of the main land. Favoured by the peculiar atmosphere of the Carboniferous era, vegetation would rapidly spread around; and, in process of time be converted into incipient Coal,—to be perfected in consistence by the inevitable subsidence resulting from the settling down of the disturbed crust of the earth. Neighbourly visits from Continental relations, would naturally cover the whole area with additional vegetable refuse, as well as with animal matter, sand, clay, and mud variously charged with Iron; which mineral,—by the process I have pointed out, would re-arrange its particles, and sedify to a suitable base. Accumulations of this kind would afford the requisite pressure, and would continue (as we have familiar instances at the present day) until, in process of time, such gradual elevations would give rise to islands of increased magnitude, or connected lands to be again fertile with vegetation, and again repeatedly submerged, until the more ancient underlying rocks became effectually consolidated, and the relative level of land and sea finally determined. Prior to such consolidation in the South Staffordshire Field, an intrusion of Igneous rocks was effected, which exercised a wonderful influence therein.

The attendant beds of Sandstone with Slate Clay or Shale are too well known to require much description. The Sandstones of the Coal measures are simple in their nature, and are evidently derived from the disintegration of older rocks. In examining Sandstone, it will be found to be composed of innumerable rounded grains of Quartz,—rarely conglomeratic; yet more rarely brecciated, but usually so minute, as to require a microscope to detect them. Externally these particles are commonly yellow,—in some instances of a red tint. The colouring matter seldom penetrates beyond the granular surface; and cannot be owing to the common process of oxidation; but, is rather the result of the general influence of ancient Volcanic action on Oceanic sediments. The density and weight of Sandstone depends on the cementing substance. Sandstones are either massive rocks, possessing irregular fracture, and water bearing; or otherwise laminated or flaggy, as Rock-binds and Linsey. In the latter instances, the thin laminæ are sometimes micaceous; elsewhere, the appearance is owing to alternate Carbonaceous layers, giving a ribbon-like character. York flagging is an exemplification of Micaceous Sandstone.

Shale and its mineral assimilants, are distinguished by various local names, such as metal, fire-clay, clunch, clod, binds, basses, batts, &c., each variety being readily recognised by the Miner. The distinction is, in some

cases, owing to the preponderance of Alumina with Silica; or otherwise by the intimate admixture of Carbonaceous and Oleaginous substances with the simple Shale or Slate Clay. Cement stones and Peldons are often highly indurated, from some cause not always obvious; and I have occasionally met with Shales so highly metamorphosed, by contact with intrusive Basalt or Greenstone, as to have become converted into perfect Jasper, of the varieties recognised by Mineralogists as Common and Ribbon Jasper. In other instances they assume the characteristics of Hornstone. I have no doubt you are familiar with Variegated Shales, altered in like manner, by artificial heat, produced by spontaneous combustion in our Coal measures. Such Shales are indurated and are converted into Porcellanite.

The chief constituent of these bodies is Alumina,—a substance produced in the decomposition of organic masses, by the recombination of their elements and proximate principles, aided by atmospheric or aqueous influence. It is a distinguishing peculiarity of terrene action, being never found as a component part of marine water; although, well known to be drifted into the sea in vast quantities. This mineral is most abundant in the superficial strata; but, from its nature as an elastic body, and its near relationship with Silica, it forms an important feature in many compounds; being, in some of them the base, and almost sole constituent,—in others mechanically combined, in various and erratic proportions. Alumina is not to be looked for in the rich black earths or vegetable moulds; as these usually consist largely of decomposed vegetable and animal matters, irregularly disposed and constantly fluctuating. Its elements are, however diffused throughout those soils; and sometimes, under favourable circumstances, it is generated therein; becoming the base and affording character and properties to argillaceous earths and clays.

The mass of aggregate of marine matter is Silica, the mineral, which, as I have elsewhere stated, enters into the composition of Sandstone; and the deeper we descend into the earth, the more pure and unmixed do we have this substance. Thus the Old Red Sandstones of Herefordshire and South Wales, may be readily distinguished from the Sandstones of the Triassic series;—Potash, Soda, Magnesia, Iron and other compounds, gradually or abruptly disappearing or rather lessening in capacity and importance, as we penetrate the lower or inferior rocks. The bulk of aggregate of terrestrial strata is Alumina; and this earth, varying wonderfully in its degrees of purity, is generally purest in Marls and Clays, which form the basis of terrestrial beds. It is worthy of remark that the combination of these minerals affords important aids to labour; being largely employed in the manufacture of bricks, tiles, pipes, retorts, crucibles, &c., (without referring to their more delicate uses in Pottery and the Ceramic Arts,) whose qualities depend on the relative proportions of Silica and Alumina, and their comparative freedom from fatal impurities.

The following is an abstract of

ARCHÆOLOGICAL NOTES ON HALESOWEN CHURCH,

which were communicated to the Society at the Halesowen Field Meeting, 13th September, 1864 :—

The Church of St. John the Baptist, in Halesowen, possesses many features of interest to the Ecclesiological Antiquarian. A large edifice has, for certainly eight centuries, existed upon the same site; and though succeeding additions, alterations, and improvements have changed the character of the original structure, each piece of later work bears its own marks of style, and the gradual progress of the completed building may be distinctly traced by the peculiar characteristics of those styles.

The present ground plan consists of a chancel, with north and south chancel aisles; a nave with north and south aisles; a tower with spire, at the west end of the nave; a porch towards the west end of the south aisle, and a vestry at the east end of the north chancel aisle; also of a nave with north and south aisles at the extreme west of the church beyond the tower, and now completely separated.

The original Norman Church appears to have been erected early in the reign of Henry I., or perhaps at the end of William II., A.D. 1090, 1120-40. The edifice had the south aisle repaired, &c., temp. Henry III., possibly about 1220. The chancel aisles were built or repaired temp. Edward III., about 1350. And the whole church appears to have been completely remodelled by the nave, tower and windows in the north aisle being built and inserted temp. Henry V. or VI., possibly as late as 1440. The latest piece of work is the window No. 1 (reckoning from the east end) in the north aisle, and which appears to be of temp. Edward IV., 1470; excepting perhaps the N.W. window in the outer west division.

Commencing then with the details of this church we will notice the interior first, and begin with the chancel.

The walls of the chancel are Norman; so are the piers of the chancel arch, together with the arch itself, possibly about 1130 A.D.—The east window is restored with tracery of too early a date, because the chancel was probably restored in 1350 with its aisles; and the east window originally would thus not have the "Geometric work" of the Early Decorated style of 1310 or 20. In the north wall are two Sedilia plain lancet shape, Early English c. 1200. The Priests' door into the vestry is decorated c. 1350. The north aisle arch with the two south arches and their octagonal pier, with two semi-piers or responds, are late decorated c. 1350. A screen appears to have been joined to the pier at the eastern surface. The roof is modern. At the apex of the north arch is an inserted stone of Norman-marked sculpture, a hand holding either a pair of scales, in which some weights in one scale exceed a stag suspended by his heels at the other end of the beam together with the empty

scale; or a staff on which are suspended some Norman steward's markettings. The chancel arch is a fine semi-circle, and of a plain character, the inner surface a plain half-round bead set with two recesses. Raised from its original position, the arch springs from two corbel responds which are plain capitals with the abacus slightly moulded. The piers where the chancel arch originally rested have their architrave corners connected into plain nook shafts, ¾ round, with capitals plain, and abacus with under edge chamfered.

The nave is much later work than the chancel; and the clerestory walls, &c., are about 1440, good Perpendicular. On both sides are one pier and two semi-piers, octagonal, with good Perpendicular capitals, moulded, and the edge surfaces of the shafts slightly recessed. The nave tower-arch is of the same altitude as those of the aisles. The clerestory windows consist of three north and south, all plain, Perpendicular, each of two lights, with three foiled heads, spandrils blank; perhaps later than the piers. Over the nave arch of the tower is a weather gable, apparently of the same date as the tower and nave. Its position there may be accounted for by regarding it as the height of an intended roof for the nave, but which was found on building to be too low, and was accordingly left; the clerestory raised, and the nave roof carried higher. The present roof is flat and modern.

The aisles are dissimilar both in length, breadth, and in the character of the windows in each. The north aisle is narrower than the south, and at its east end is terminated by a wall, now pierced by a modern door-way opening to the vestry. Both aisles retain the original corbels of their roofs, as well as the new corbels for the lately raised modern roofs. The modern galleries rest on new good Perpendicular corbels let into the piers and walls The north aisle contains four windows, all Perpendicular.

The doorway at the west end of the north aisle is blocked up. Behind the N.W. chancel pier is a remnant of some projecting masonry, probably formerly connected with the turret staircase outside the north aisle near No. 1 window, and which probably led to the rood loft over the chancel screen. A blocked-up narrow doorway in the north wall, now only discernible by a label crocketed and finialed, confirms this.

The south door-way is Norman, with the outer surface ornamented with jamb-shafts and recessed mouldings. The outer arch is three-fold recessed. The first being plain, the second a double row of chevrons, and the third a triple row of half-round beadings. The arch springs from a plain abacus, with under edge chamfered. The jamb-shafts are two on each side; those on the east side have their caps ornamented with stiff scroll work, those on the west side the caps with the cone-shaped ornament.

The porch was possibly Norman, since the Norman carved corbels for the roof exist; probably the old work was used up with the early English when

it was repaired or re-built, then the porch doorway was built c. 1230, a three foiled lancet is in east and west sides of the porch.

The tower is square; perhaps it replaced the original Norman tower. The four ground arches were originally open; the splay of them is recessed like the nave piers, but they spring from a plain abacus. The roof is groined with good late Perpendicular rib-mouldings meeting an octagonal centre, left open to raise bells. In the N. E. angle of the tower is a staircase to the belfry and top; it is entered by a door from the north aisle. To light the ground story of the tower are two windows, one in north and south walls. Late Perpendicular, three lights, three foiled, with supermullions.

The font is very early Norman; possibly older than any portion of the church, and might be dated near 1110; probably the bowl is that date; the stem and four legs have a later character, and were possibly added 1140-50.

The west division of the church, now separated, was formerly open with the other parts. The nave retains its original Norman character. From a pier and two semi-piers north and south of nave, spring two semi-circular arches, once recessed, but quite plain. The piers are low, square-oblong, with half shafts, (except on nave surface) also nook shafts, with plain abacus and capitals of cone pattern. The aisles are probably Norman walls. North aisle has two windows, first good Perpendicular c. 1440, three lights, five foiled; second at west end very late Perpendicular four lights, five foiled, both with supermullions. South aisle has three Decorated windows (of which it is difficult to decide the date) perhaps 1320, three lights, five foiled. Over the west door is a large lance window, Decorated. The west door is plainer than south door; the archway consists of a double recessed arch, having one jamb-shaft north and south; one arch is a triple row of billets and chevrons lightly cut, second row is a triple row of chevrons. Over the arch is a plain chamfered label ending in the projecting abacus.

EXTERNAL GENERAL VIEW.

The east wall is certainly Norman; it has two string courses and pannelling of interesting arches on shafts. The south-east chancel buttress is Decorated.

The vestry has an Early English, or perhaps Decorated character, the original east window of it was probably Early Decorated like the doorway c. 1340.

The tower is divided by two string courses, has an embattled parapet, a good octagonal spire, with three sets of four spire lights, finialed. Within the belfry are eight bells, none old.

In the church-yard is a mutilated effigy of a Priest, at the west end of the tomb are two panels, first containing the remains of a representation of the Trinity, the second of the Crucifixion, c. 1350.

A Meeting of the Committee was held on Tuesday, December 6th, 1864. Present, Messrs. Silas Bowkley, (Chair) S. Allport, C. Ketley, E. Hollier, C. Gray, T. Brettell, L. P. Capewell, W. Madeley, Henry Burton, Henry Johnson, J. Solly, S. Bailey, and the Secretary.

The proceedings chiefly related to the matter in dispute between the Society and the Mechanics' Institute, particulars of which are given collectively.

At the December Meeting of Ordinary Members the following paper from Mr. John Ward, Longton, was read:—

"THE DISTRIBUTION OF ORGANIC REMAINS IN THE NORTH STAFFORDSHIRE COAL FIELD."

THE rich and valuable Coal-field of North Staffordshire is interesting to the Palæontologist on account of the wonderful fauna which it contains. This Coal-field is divided into three parts. 1st.—The Potteries' Coal-field. 2nd.—The Wetley and Shafferlong Coal-field, which is about three miles in length, and half a mile in breadth, and extends from Wetley Abbey on the South, to Shafferlong on the North. It contains only two of the lowest coals, one twenty inches, and the other about nine inches in thickness. They have little or no commercial value, and at the present time this Coal-field is not worked. The 3rd is the Cheadle Coal-field, which is about five miles in length and four in breadth. It contains several beds of coal, but is not worked to any great extent.

The area of coal measures exposed is about 70 square miles, and it is probable that some of the Upper beds will, at no distant date, be worked from under the Permian and New Red Sandstone strata, which cover the Southern and Western portions af the Coal field.

The Coal-field we shall notice especially, is that of the Potteries. In form it is triangular, the apex lies near Congleton, and it stretches out on the South to a width of about 10 miles. Weston Coyney is the uttermost limit it has been worked to the East, and Apedale to the West. On the North and East it is bounded by Millstone Grit which forms a bold ridge at Wetley. On the South by Permian and New Red Sandstone strata.

The Coal measures have been divided by Mr. Smyth into four distinct parts:

1st.—The Upper measures consisting of marls and clays, down to the top Red mine, with a probable thickness of 1,000 feet.

2nd.—The Pottery Coal and Ironstone measures, down to the Ash or Rowhurst Coal, from 1,000 to 1,420 feet in thickness.

3rd.—Lower thick measures, including the Winpenny and 17 or 18 seams of coal above two feet thick, from 1,400 to 2,400 feet in thickness.

4th.—Lowest measures, including the Wetley and Shafferlong coals, about 800 feet in thickness.

The aggregate thickness of coal measures is about 5,600 feet. We shall notice the characteristic fossils of each bed in the four divisions.

The Upper, or 1st division, is not rich in organic remains; the characteristic fossil is *Anthracomya Phillipsii*, which is abundant.

The 2nd, or Pottery coals and ironstones are the great storehouses wherein are deposited the most wonderful and beautiful series of organic remains. These we believe cannot be surpassed by any single Coal-field in England.

About 12 yards above the Bassey mine ironstone, is a bed of freshwater limestone which contains *Spirorbis carbonarius* and scales of fish. This bed we are informed corresponds to a bed more largely developed at Ardwick near Manchester. We have traced it from Longton through Fenton and Shelton, but cannot at present define its limits. At Hartshill and near Newcastle railway station are similar beds, but whether they represent the bed in question we are unable to say.

The Bassey mine ironstone (Red Mine in some localities) is easily recognised by the immense number of *Anthracomya Phillipsii* and large specimens of *Stigmaria*, which occur in layers throughout the Ironstone.

The Gubbin Ironstone shale contains several genera of fish. At Shelton it has yielded a fine specimen of *Megalichthys Hibbertii*. Teeth of several species of fish are common; one, the *Diplodus gibbosus*, is finer in this bed than in any other we are acquainted with. Fin-spines are rare, with the exception of the small spine of *Rhizodus Hibbertii* which is abundant. *Palæoniscus*, which in other beds is common, is rare if not altogether absent. Coprolites of a large size are abundant, which fact, so far as our researches have gone, is unfavourable to the presence of fish.

Passing over the Great-row and Cannel-row Coals we come to the Pennystone Ironstone which we believe is only worked at Shelton, and contains but few fossils, and forms a striking contrast to the rich fossilliferous stone of the Shropshire Coal-field, which is filled with fossils.

We come next to one of the most interesting beds in the whole Coal-field, namely, the Deep-mine Ironstone, which is remarkable as being full of beautiful and complete fish. The material in which they occur, is a fine black compact shale, which splits well under the hammer. It contains several species of *Palæoniscus*; and one new genus (*Cycloptychius carbonarius*, Hux) discovered by Mr. Molyneux, which appears, so far as our researches have gone, to be confined to this bed. *Acanthodus* of two species is not rare, nor is *Cœlacanthus*, *Diplodus*, *Megalichthys* and *Ctenoptychius*. At Longton it is the richest and best Ironstone, and is worked to a greater extent than in any other locality. Although it is worked in other districts yet nowhere do we find it so rich in fossils as at Longton.

The Chalky-mine Ironstone occasionally contains fine specimens of fish. We have collected from it, large specimens of *Platycomus*, *Megalicthys*, &c.

At Longton, about 12 yards below it is a bed of Sandstone, saturated with mineral tar, which is collected in one of the shafts and used for various purposes. The New-mine Ironstone is rich in fossils in some localities.

The Hanbury-mine Coal shale contains several species of fish, which we have collected from various sinkings, as it is not worked.

The New Ironstone or Rag-mine is filled with the remains of fish, generally in a fragmentary condition, indiscriminately mixed together, doubtless owing to the action of water. One thin band of a few inches in thickness is composed of teeth, broken spines, coprolites and other remains. The spines of *Orthacanthus* and *Ctenacanthus* are occasionally found in fine condition. Teeth of *Megalichthys*, *Petalodus*, *Ctenoptychius*, and *Diplodus* are common and very fine, especially *Ctenoptychius*. This bed bears a great resemblance to the Brown Mine of the Western portion of the Coal-field, both in the character of the shale and the fossils, the only exception being that *Anthracomya Adamsii* occurs in the latter bed at Kidsgrove, and is not found in the New Ironstone. The Bay Coal is not of much commercial value, but is interesting to the Palæontologist, as the shale contains marine fossils. The discovery of these fossils in Upper measures is interesting if not important; they clearly prove that a totally different state of things prevailed during the deposition of this bed. A similar discovery has been made in the Lancashire Coal-field by Messrs. Hull and Green, who discovered marine fossils at Ashton. We have searched for a continuation of them in beds which intervene between the Bay Coal and beds in which they were previously known to occur, but only in one instance have we detected them. We trust that gentlemen residing in other Coal-fields, and who are engaged in their investigation, will search for these fossils in Upper measures; we shall then be in a position to state whether their occurrence at widely separated intervals is general, or only confined to this and the Lancashire Coal-field.

The most important bed is the Knowles or Winghay Ironstone. The shale has much the appearance of that of the Deep-mine, and like it is exceedingly rich in organic remains. Its most characteristic fossil is *Platysomus* of which it contains two species. *Megalichthys* is common in this bed. Species of *Gyracanthus* and *Ctenacanthus* are not rare, nor are the teeth of *Pleurodus*, *Helodus*, *Diplodus*, and *Ctenoptychius*. We frequently find nodules of ironstone imbedded in the shale, which often forms a "winding sheet" for a *Rhizodus*, or incloses a mass of *Anthracomya Adamsii*.

Lower Thick Measures.

This division contains the chief Furnace and House Fire Coals, several of which are valuable for potters' as well as for domestic use.

The Ash Coal has a hard cannel-like bass which contains several species of *Palæoniscus*—one, a characteristic species, with scales covered with granules. *Rhizodus* also occurs, and occasionally we find a specimen of *Gyra-*

canthus or *Ctenacanthus*, and more rarely *Orthacanthus*. *Helodus* teeth of three species occur in it. *Cladodus* is common, and associated with it we have found the dermal tubercles which were attached to the skin of the fish. Scales of *Cœlacanthus* and *Platycomus* are common, but in a thin band of ironstone we occasionally find entire fish.

The Burnwood Ironstone contains splendid specimens of *Anthracomya Adamsii*, which is abundant, not only in the ironstone itself, but in the shale also. Fish are rare.

From the Moss Coal measures we have collected several species of *Anthracosia*. The shale, hard and enamel-like, contains scales of *Rhizodus granulatus*, spines of *Pleuracanthus*, &c.

The Ten-foot Coal measures at Hanley have a bed of shells called the "Mussel bed." It consists of compressed shells, about two feet in thickness, made up of *Anthracosia* and *Anthracoptera* of several species.

The Sparrow Butt or Hard Coal, is rich in several species of *Anthracoptera* one or two of which are new. *Anthracomya* is also abundant, with the exception of *A.modiolaris*.Sow. which is rare. These shells are only found in a light coloured marl, but in a black hard shale we find teeth and scales, and abundance of *Spirorbis carbonarius*. Murch.

The Cockhead* Ironstone, which assumes a nodular character, is filled with fine specimens of *Anthracosia* of several species, the most common is *A.acuta*. In the Ironstone we find *Rhizodus*, which, to a practised eye, can frequently be detected in the stone by the peculiar form it assumes. More rarely we find *Gyrolepis*, *Acanthodus*, and *Cœlacanthus*.

Lowest Measures.

In this division there are few coals of commercial value; but it contains a remarkable bed of earthy hæmatite of great value. It is about 22 inches in thickness, but varies considerably. It lies from 1 to 14 feet above the Millstone Grit, from which it is separated by a bed of Marl or Clay.

Many of the shales in this division are full of organic remains. *Aviculopecten papyraceus* occurs in thousands. *Posidonia*, *Goniatites* of several species. *Lingula* and *Orthoceras* are equally abundant. *Anthracosia* is rare, but we believe it has been found in the hæmatite.

Briefly to recapitulate we find that several genera of fish and mollusca occur in all the beds from the top to the bottom. *Megalichthys* is not absent from any one bed. *Palæoniscus*, *Cœlacanthus*, *Platysomus* have a similar range.

Whether or no the so-called fresh water fossils are so in reality, we leave future investigations to determine. We believe they partake more of a marine character, but whether we are correct or not, time will decide.

Of the Flora of this Coal-field we know but little, we have appended a list

* Pronounced Cokshead.

of some of the species that are well known. We do not send it forth as complete, as we have many specimens not named.

The list of fossils has been carefully drawn up by myself, and I beg to acknowledge at the same time the discoveries of my fellow labourer Mr. Molyneux, both having been engaged for some years in collecting the organic remains of this Coal-field. We hope others will be induced to do the same in other Coal-fields. There is much yet remaining to be done. We know little comparatively of the wonderful Flora and Fauna of our coal measures.

In closing, we remark, that we have not at present found crustaceans or insects such as have been detected in the Shropshire, Lancashire, and Scotch Coal-fields. Of reptilian remains we are doubtful. When our collections have been examined by competent authority, many species will be added to our list.

MEGALICHTHYS HIBBERTII AG.

Agassiz Pois. Fos. Vol. 2, Tab. 64, Fig. 1.

Of the many beautiful fish remains found in the North Staffordshire Coal-field, none are more abundant than those of the *Megalichthys*. We can scarce examine a bed of coal or ironstone without meeting with some portion of this remarkable fish.

It was first introduced to public notice by the late Dr. Hibbert, who discovered it in the Burdiehouse Limestone. Afterwards it was exhibited to the Geological section of the British Association, held in Edinburgh, in the year 1834. It then received its present name from Agassiz.

The average length of the *Megalichthys* is said to be about three feet. The author has reason to believe that it occasionally exceeded that length. A fine head of this species in his collection, not quite perfect, measures sixteen inches in length, and twelve in breadth; this must have belonged to a large individual.

No coal measure fish that we are acquainted with presents such a remarkable appearance as this one; covered as is the body with black (or sometimes brown) quadrangular scales, of a beautiful glossy japan, which extend from the head to the tip of the caudal fin. The head is defended with plates of solid bone of great thickness, and of the same bright enamel as the scales. The jaws are long, and armed with large reptilian teeth, placed at intervals in the jaw, and between which there runs a row of smaller teeth, admirably adapted to retain in their grasp the little *Palæoniscus* on which the creature no doubt fed.

Abundant as is the *Megalichthys* in this Coal-field, yet no complete specimen has yet been found. In the Museum of Practical Geology, Jermyn Street, London, is the half of one, presented by Mr. Garner. This specimen was found in the Gubbin Ironstone, at Shelton Colliery. Portions of the body, head plates, teeth, vertabræ, and other remains, are by no means rare.

From the manner in which this fish is armed, it would appear to have been a heavy swimmer, but we learn on a closer examination that the internal structure of the armour was such, that strength was combined with the smallest amount of material.

Often have we been lost in wonder, as we have laid open portions of this mailed monarch! We have asked ourselves, what need for all this assemblage of protection? In the remote past, when this creature lived, was there war and bloodshed amongst animals such as exist now? The enigma is solved on finding that with this fish there existed others armed with terrible spears, and ponderous clubs. Doubtless many, and fierce were the battles then waged. But we may rest assured that the *Megalichthys* would prove no mean foe. Two, if not more species of *Megalichthys* occur in this Coal-field.

RHIZODUS *Owen.*

Of this genus there are several species found in this Coal-field.—One *Rhizodus granulatus* Ag is found in nearly all the coal beds. The scales are of an oval form, with granules irregularly scattered on them. The teeth are long and straight, with fine striæ running from the base to the point. *Rhizodus minor*, is a much smaller species, and has small circular scales. *Rhizodus incurvus* Newb. is rare, only one jaw has been found. This was found by the author, in the New Ironstone. The teeth are strong, and have re-curved points. In the Knowles, Cockhead, and other beds, occurs a species of *Rhizodus* with oval scales, richly ornamented by concentric circles. The fins are large and lobate. The head is broad and flat, the jaws are filled with fine teeth. It ranges from about 5 inches to 2 feet in length. Only teeth of *Rhizodus lanciformis* have yet been found. They are broad, thin, and lancet-shaped. It occurs in the Gubbin and Brown Ironstone, and Wood's mine coal bass.

HOLOPTYCHIUS. *Ag.*

This genus is rare. We occasionally find a species with the head covered with deep pit-like marks. The jaws have several large strong teeth, strongly striated, and between which are deep cavities in which the teeth of the opposite jaw fitted. There are also scales of a large species of *Holoptychius* found in the Deep Mine and New Ironstones. Some of these measure 2¼ inches in diameter.

CŒLACANTHUS. *Ag.*

This genus, according to the researches of Professor Huxley, is allied to Undina. Only one species is found, *C. lepturus*. It occurs most perfect in the Deep Mine. It is remarkable for having the air bladder well preserved and *in situ*. This is well shown in many of our specimens.

CYCLOPTYCHIUS. *Huxley.*

This is a new genus from the Deep Mine Ironstone Shale, to which bed it appears to be confined. It is about five or six inches in length, covered

with thin cycloidal scales, ornamented with concentric ridges. The head appears to have been strong, and some of the head plates are exquisitely ornamented. The jaws are armed with sharp pointed teeth. The dorsal and anal fins are large, and placed much nearer the caudal fin than in *Palæoniscus*, from which it differs also in its slender form. The pectoral and ventral fins are lobate. The tail is heterocercal, and the upper lobe is covered with scales. The most common species is *C. carbonarius*. We believe there is another.

GYROLEPIS. *Ag.*

This genus occurs generally in a fragmentary condition. We had the good fortune, a short time ago, to discover a complete specimen. It is about 12 inches in length. The scales are thick and long, and richly ornamented with bold ridges. The dorsal, anal, and ventral fins, are large and powerful. From the dorsal fin to the tip of the caudal fin, there runs a row of thick ridge scales, which overlap each other like ridge tiles on the top of a house. The head is large, and the jaws are armed with strong teeth, thickly set. This genus is somewhat rare. We have two species unnamed.

ACANTHODUS.

This beautiful genus, so common in the Old Red Sandstone, is also found in one or two of the ironstone shales. The body of the fish is covered with minute diamond-like scales, which near the head appear to assume a skin-like character, The fins consist of a small flat spine in one species, to which is attached a scaly membrane. The pectoral fin spine appear to be larger than the others. The head has not yet been found entire. It was, no doubt, composed of cartilage, and covered with skin, which fact appears to be borne out by the appearance of the scales near the head, mentioned above. The tail is altogether covered with scales, giving it a pretty appearance. We have two species, which differ in the position of the fins. Both are unnamed.

PALÆONISCUS. *Ag.*

This genus is abundant in all the measures from the upper to the lowest. There are a number of species, several of which occur in the deep mine ironstone shale, in which bed they often occur perfect. There is one thing that cannot fail to strike us, they all appear to have died under extraordinary circumstances. We generally find the mouth extended to the utmost stretch, the tail is bent round to the head in many instances; and the general appearance is one of agony. How, or by what means, their death was brought about, we know not; it must have been one of no ordinary kind to have distorted these fish into the various forms they assume. The Ash Coal Shale has a species with scales covered with granules. There are also several species in the Knowles Ironstone Shale, all of which are unnamed with the exception of one *P. Egertonii*.

PLATYSOMUS. *Ag.*

This genus is represented by two (if not three) species, one of which is common. This species averages about 8½ inches in length, and about 2 inches in breadth The head is large, the jaws are armed with numerous fine-pointed teeth. The dorsal fin commences at the ridge of the back, and extends to the upper lobe of the caudal fin. The anal fin is the exact counterpart of the dorsal fin. The pecteral fins are situated close to the head. The caudal fin is heterocercal. The body of the fish is covered with long narrow scales, ornamented with numerous parallel striæ. It is difficult to obtain perfect.

The second species differs from the first in several important points, and occurs of a much larger size than the first. We have a specimen 7 inches in length, and 6½ inches in breadth. At the dorsal and anal ridges, the body of the fish assumes a much more pointed form than the first, and has a small, strong, slightly curved spine. The body of the fish is covered with scales, ornamented with dots or tubercles. Second, the articulating ribs are strong, and when *in situ* give a marked character to the fish. The jaws are small triangular bones, with blunt serrations, which served as teeth, and would be well suited for crushing the shells and crustaceans on which it no doubt fed. The eyes of the fish are placed high and forward, as shown by a splendid example in the author's collection. This species occurs in the Knowles, Deep-mine, and Brown-mine Ironstone Shales. In the latter bed it is common.

DEFENSIVE ARMATURE.

ORTHACANTHUS CYLINDRICUS *Ag.*

The defensive armatures of the carboniferous fishes are remarkable for the formidable appearance, which some of them present. Not only did they serve for defence, but for torture,—of these, none presents a more formidable appearance than that of the *Orthacanthus*. It is a long round spine, of about 18 inches in length, tapering to a fine point. On one of its sides there runs a double row of thorn-like barbs, hooked downwards, and extending to within a few inches of the base. It is probable that this spine was not articulated to the vertebræ, but simply inserted into the flesh.

Of the individual to which this spine belonged, we know nothing. We may be well assured that its possession would be quite able to defend itself against all assailants.

This spine is somewhat rare. We have fine specimens from the New Ironstone, Deep-mine, Ash Coal Shale, and Chalky-mine Ironstone.

LEPTACANTHUS.—Agassiz Pois. Fos. Vol. 3, Tab. 1 a.

Of this genus, we find one species *L. longispinus*. It resembles the *Orthacanthus*, and like it has a double row of barbs, but they are more blunt, and have a groove or hollow between them. The spine is slightly curved, and is very rare.

PLEURACANTHUS LÆVISSIMUS *Ag.*

This is a short round spine, tapering to a fine point. On its two sides there runs a row of barbs which extend to within a few inches of the base. The well-known *Diplodus gibbosus*, belonged to the same individual as did this spine. It is very rare. We occasionally find specimens in the Moss-coal Shale, and Deep-mine Ironstone Shale.

CTENACANTHUS HYBODOIDES *Eg.*

See Fig. Quart. Journ. Geol. Soc. Vol. 9, Pl. XII.

This spine is occasionally found in the Knowles, New Ironstone, and Gubbin Ironstones. It averages 9½ inches in length, (inclusive of about 2 inches, which were imbedded in the flesh) and 1½ inches in breadth at the broadest part. It is ornamented with parallel longitudinal ridges, and a double row of tubercles which extend from the base to the apex.

GYRACANTHUS FORMOSUS *Ag.*

Agassiz. Pois. Fos., Vol. 3, Tab. 5, Fig. 4 to 8.

This spine is too well known to need any description. It is elegantly ornamented by lines arranged in a zig-zag fashion, and which render it easy to be identified. In several beds of ironstone it occurs in fine condition, but nowhere have we seen it so fine as in the Newsham seam of the Northumberland Coal-field, from which we have specimens 16 inches in length, and 6 inches in diameter.

GYRACANTHUS TUBERCULATUS *Ag.*

Agassiz. Pois. Fos., Vol. 3, Tab. 1 a., Fig. 1 to 7.

In general appearance this spine bears a great resemblance to *G. formosus*, but instead of the lines it is covered with tubercles. It is somewhat rare. We have good specimens from the Knowles Ironstone Shale, and Ash Coal Shale.

In addition to the spines enumerated, there are several others undetermined. One of these is a flat spine, about 6 inches in length, curved like a scimitar. The outer edge has a fine groove, the inner is a much sharper than the outer. It belonged to a species of *Rhizodus*, and although the smallest, yet it was not the least formidable of the armature of the coal measure fishes, as it seems well adapted for cutting open any fish that assailed it.

There is also a small stiletto-like spine, about 4 inches in length, devoid of any serration, and appears to have been imbedded in the back of the fish. Among recent fish we find that the dog fish *(Spinax acanthais)* is armed in a similar manner. It has a spine attached to the dorsal fin, which bears a great resemblance to the spine in question. Whatever may have been the purpose to which these spines were fitted, we may rest assured that they filled important offices in the economy of nature. Long before man appeared on this earth, war and bloodshed were not unknown. The fishes that peopled

the carboniferous seas, then as now, met in deadly conflict. The *Orthacanthus* and *Pleuracanthus*, with their terrible spines would deal death and destruction on all around. The *Gyracanthus* and *Ctenacanthus* would make terrible impressions on the armour-plated *Megalichthys*, and safety would only be attained by flight.

Fish Teeth.

Teeth of fish are abundant, and distributed more or less through all the beds in this Coal-field. One of the most common, yet not the least curious tooth is *Diplodus gibbosus*. It consists of two re-curved fangs, between which is a smaller one; the base of the tooth is broad and strong, and occasionally shews where the vessel passed that nourished it. We have many times found the skin of the fish associated with the teeth. No less than 60 of these teeth belonged to one individual.

Of the genus *Ctenoptychius*, there are three species found in this Coal-field, *C. apicalis*, *C. denticulatus*, and *C. pectinatus*. Of *Petalodus* we find one species. Of *Pleurodus* several species. Of *Helodus* we have several new species in addition to the common species *H. simplex*. Of *Megalichthys* teeth we find two species which are common, we are unacquainted with a bed that does not contain them. Occasionally we find jaws with the teeth *in situ*. We have seen a jaw of *Megalichthys* found at Silverdale, that had no less than sixteen large teeth placed at intervals along its base, and between which there ran a row of minute teeth.

Teeth of *Rhizodus* and *Holoptychius* are more rare. In the Gubbin Ironstone and Wood's Mine Coal Shale, we find a flat lancet-shaped tooth, with sharp cutting edges, this we refer to *Rhizodus lanciformis* Newb. It was discovered in this Coal-field some years ago by Mr. Garner, and figured in his Natural History of the county of Stafford. It is also found in the Durham and Burnley Coal-fields.

Palates.

Ctenodus cristatus.

Agassiz. Pois. Fos., Vol. 3, Tab. 19, Fig. 16.

This fine palate is occasionally found in the Knowles, and New Ironstones, from which beds we have several perfect specimens.

We have in addition four other palates, one of which we refer to the genus *Ceratodus* of Agassiz. The others we believe to be new.

We have several species of teeth of the genus *Pleurodus* Ag.—one *P. affinis* is very rare. Also other species yet undescribed.

Mollusca.

Several of the beds are filled with fine specimens of *Anthracosia*,—the Cockhead Ironstone, at Adderley Green in particular. In this bed we find often in a nodular ironstone *A.acuta*, and *A.ovalis*, in abundance. *A.lateralis* also occurs in the same bed. The *A.robusta*, which in the Lancashire Coal-

field attains a large size, is small in this Coal-field, with the exception of compressed specimens found in the shale of an old working at Kidsgrove. *Anthracosia* is often found in a vertical position, from which we infer that it was a burrowing shell. It has a wide range, and is found in the lower beds, and occasionally in the hæmatite shale of the Churnet Valley.

Anthracomya is represented by several species, the type of which is *A. Adamsii*, splendid specimens of which occur in the Burnwood Ironstone. It is also found in the Knowle Ironstone, but does not attain so large a size as in the former bed. There are several other species, one of which *A. pumila* is found in the hard mine. *A. Phillipsii* is very common.

Anthracoptera is abundant in the hard mine, and of this there are several species. These occur in a bed of clay or marl.

Aviculopecten is abundant in the lower measures. It also occurs in one bed in the upper coal measures. The only species we find is *A. papyracea*.

FLORA.

The following list is by no means perfect. We only give those well-known.

Calamites cannæformis and others
„ approximatus
„ undulatus *Brong.*
Sphenopteris Honinghausi (deep mine)
„ laltifolia
„ tenuifolia
„ lonchilia
Cyclopteris reniformis or flabellata
Asterophyllites charaformis
Ulodendron minor
Lepidodendron elegans
„ obovatum
„ Sternbergii
Knorria Sellonii
Halonia Sp.
Sigillaria reniformis
Stigmaria ficoides
Lepidostrobus Sp.
Neuropteris cordata
„ new species with serrated edge
„ dubia Brong.
Pecopteris Sp.
Asterophyllites Sp.
Sphenophyllum Sp.
„ Schlotheimii
Dadoxylon Sternbergia

A LIST OF THE FOSSILS FOUND IN EACH BED.

1st Upper Measures.

Silverdale	*Shelton*
Top red mine .	Red shag stone
Black band	Gutter coal and ironstone
Red shag	
Red mine and coal	Anthracomya Phillipsii

2nd Pottery Coals and Ironstones.

Measure.	Name of Fossil.	Locality.
Bassey mine Iron-	Stigmaria large	Longton
stone 1 ft. 1 in.	Cytheropsis	Shelton
	Spirorbis carbonarius *Murch.*	Fenton
	Megalichthys Hibbertii *Ag.*	
	Diplodus gibbosus *Ag.*	
	„ minutus *Ag.*	

Between the Bassey mine and the Peacock coal are several beds of "Marl," which contain *Calamites* and other common coal plants.

Spencroft Coal	Palæoniscus Sp.	Shelton
1 yd. 2 ft.	Rhizodus Sp.	
	Diplodus gibbosus *Ag.*	
	Anthracomya Phillipsii	
	Spirorbis carbonarius *Murch.*	
	Large Coprolites	
	Megalichthys Hibbertii *Ag.*	
	„ Sp.	
	Ceratodus (?) palate	
	Holoptychius Sp. *Ag.*	
	Platysomus Sp.	

Gubbin Ironstone	Diplodus gibbosus *Ag.* (very fine)	Shelton Collieries.
1 ft. 4 in.	Cœlacanthus lepturus *Ag.*	
	Ctenacanthus hybodoides *Eg.*	
	Pleuracanthus lœvissimus *Ag.*	
	Rhizodus Hibbertii (spines)	
	„ lanciformis *Newbury*	
	Anthracomya Phillipsii, abundant	

Measure.	*Name of Fossil.*	*Locality.*
Great Low Coal, 2 yds. 2 ft.	Megalichthys Hibbertii *Ag.*	Longton
	Ctenoptychius denticulata *Ag.*	Golden Hill
	Cœlacanthus lepturus *Ag.*	
	Platysomus Sp.	
	Diplodus gibbosus *Ag.*	
	Anthracomya Phillipsii	
Cannel Mine Coal and Ironstone series. Little Mine of Silverdale, 10 in.	Cœlacanthus lepturus *Ag.*	Golden Hill
	Rhizodus Sp.	Burslem
	Pleuracanthus lævissimus *Ag.*	Silverdale
	Ctenoptychius apicalis	Fenton
	„ pectinatus *Ag.*	
	Beyrichia arcuata	
	Sanguinolites	
	Spirorbris carbonarius, *Murch.*	
	Anthracomya Phillipsii	
	Pleurodus Rankenii, *Ag.*	
	Megalichthys Hibbertii	
Wood's Mine Coal Shale, 9 in	Calamites	Longton
	Lepidodendron Sp.	
	Palæoniscus Sp.	
	Megalichthys Hibbertii	
	„ Sp.	
	Diplodus gibbosus *Ag.*	
	„ minutus *Ag.*	
	Gyracanthus formosus *Ag.*	
	Rhizodus lanciformis *Newbury*	
	„ granulatus *Ag.*	
	A large fish with strong bony spine	
	Cœlacanthus lepturus *Ag.*	
Pennystone Ironstone 1 ft. 1 in.	Megalichthys Hibbertii *Ag.*	Shelton
	„ Sp.	
	Diplodus gibbosus *Ag.*	
	Gyracanthus formosus *Ag.*	
	Ctenoptychius apicalis *Ag.*	
	Petalodus Sp.	
	Platysomus Sp.	
	Anthracomya Phillipsii	

The Deep-mine Ironstone occurs in three bands, as under:—

A small band of Ironstone containing *Platysomus Sp.*

	yd.	ft.	in.	
Bass ...	1	0	0	contains plenty of *Diplodus gibbosus* teeth
Ironstone	0	0	3	
Bass ...	0	2	0	does not contain many fish
Ironstone	0	0	2	
Bass ...	0	2	0	this contains the best fish
Ironstone	0	0	2	
Bass	0	0	4	contains fish.

Measure.	*Name of Fossil.*	*Locality.*
Deep-mine Iron-	Megalichthys Hibbertii *Ag.*	Longton
Ironstone.	„ Sp.	Fenton
Sheath mine and	Rhizodus minor *Ag.*	Shelton.
Black Stone of	„ granulatus *Ag.*	It is much richer at
the Western side	„ Sp.	Longton and
of the Coal-field.	Holoptychuis Sp. (large scales 2 or 3 inches in diameter)	Fenton in organic remains than at Shelton.
	Palæoniscus Sp. (six)	
	„ Egertonii *Ag.*	
	Platysomus 2 species	
	Gyrolepis Sp.	
	Cœlacanthus lepturus *Ag.*	
	Ctenacanthus hybodoides *Eg.*	
	Orthacanthus cylindricus *Ag.*	
	Pleuracanthus lævissimus *Ag.*	
	Gyracanthus formosus *Ag.*	
	Diplodus gibbosus *Ag.*	
	„ minutus *Ag.*	
	„ Sp.	
	Ctenoptychius apicalis *Ag.*	
	„ denticulatus *Ag.*	
	„ pectinatus *Ag.*	
	Helodus simplex (rare)	
	Cladodus Sp.	
	Ctenodus Sp.	
	Acanthodus Sp.	
	„ Sp.	
	Beyrichia arcuata	
	Neuropteris cordata, *Brong.*	
	„ new Sp. with serrated edges	

Measure.	*Name of Fossil.*	*Locality.*
	Sphenopteris Hœninghausi	
	Cycloptychius carbonarius, *Huxley* (new genus)	
Rusty Mine, 8 in.	Helodus simplex, *Ag.*	Sneyd Green
	Anthracoptera Sp.	
	Anthracosia Sp.	
	„ lateralis, *Brown*	
	Spirorbis carbonarius, *Murch.*	
Chalky-mine Ironstone.	Acanthodus Sp.	Longton
	Megalichthys Hibbertii, *Ag.*	Fenton
1st. Ironstone, 3in	„ Sp.	Silverdale
Bass, 2ft. 3in.	Diplodus gibbosus, *Ag.*	Burslem
2nd. Ironstone, 2	„ minutus, *Ag.*	
Bass, 1ft. 9in.	Palæoniscus Sp.	
3rd. Ironstone, 7in	Gyrolepis Sp.	
	Platysomus Sp.	
	Gyracanthus formosus, *Ag.*	
	Orthacanthus cylindricus, *Ag.*	
	Anthracomya Phillipsii	
New Mine Ironstone, 1 foot.	Plæoniscus Sp.	Kidsgrove
	Platysomus Sp.	Newchapel
	Rhizodus Sp.	Longton
	Megalichthys Hibbertii, *Ag.*	Shelton
	„ Sp.	
	Ctenoptychius apicalis, *Ag.*	
	„ denticulatus, *Ag.*	
	Petalodus	
	Helodus simplex	
	Cladodus Sp.	
	Pleuracanthus lævissimus, *Ag.*	
	Diplodus gibbosus	
	„ minutus	
	Gyracanthus formosus, *Ag.*	
	Anthracomya Adamsii	
	„ Phillipsii	
	Anthracosia robusta	
	„ Sp. (two)	
	Anthracoptera Browniana	

Measure.	*Name of Fossil.*	*Locality.*
Hanbury Mine	Platysomus Sp.	Longton
Coal bass,	Palæoniscus Sp. 2	
2 yds.	Megalichthys Hibbertii, *Ag.*	
	Diplodus gibbosus, *Ag.*	
	Rhizodus granulatus, *Ag.*	
New Ironstone	Ulodendron minor	Fenton
or	Sigillaria	
Rag Mine,	Lepidodendron obovatum, *Sternb.*	
1 ft. 6 in.	Calamites cannæformis, *Sch.*	
	Annelide-like casts	
	Palæoniscus Sp.	
	Platysomus Sp.	
	Cælacanthus lepturus, *Ag.*	
	Gyrolepis Sp.	
	Rhizodus granulatus, *Ag.*	
	„ Sp.	
	„ incurvus, *new*	
	Holoptychius Sp., large scales	
	„ Sp.	
	Ctenoptychius apicalis, *Ag.*, fine	
	„ denticulatus, *Ag.*	
	„ pactinatus, *Ag.*	
	„ new	
	Petalodus Sp.	
	Cladodus Sp.	
	Megalichthys Hibbertii, *Ag.*	
	„ Sp.	
	Orthacanthus cylindricus, *Ag.*	
	Pleuracanthus lævissimus, *Ag.*	
	Leptacanthus longispinus, *Ag.*	
	Ctenacanthus hybodoides *Eg.*	
	Ctenodus cristatus *Ag.*	
	Diplodus gibbosus *Ag.*	
	„ minutus *Ag.*	
	„ Sp. (two)	
	„ Sp.	
	Teeth with numerous cusps, new	
	Anthracomya Phillipsii	

At Longton, five yards below the New Ironstone, is a bed of grey rock

which contains several species of ferns, &c. Below this rock are seven yards of rock and shale which overlie the Bay Coal, the shale of which contains marine fossils. There are several genera in addition to those in our list.

Measure.	*Name of Fossil.*	*Locality.*
Bay Coal Shale.	Cœlacanthus lepturus *Ag.*	Longton
(Coal not worked)	Platysomus Sp.	
	Palæoniscus Sp.	
	„ Sp. same as in stinking coal shale	
	Megalichthys Hibbertii *Ag.*	
	Diplodus gibbosus *Ag.*	
	Rhizodus Sp.	
	Nautilus Sp.	
	Discina nitida	
	Aviculopecten papyraceus	
	Lingula squamiformis	
	„ mytiloides	

Underneath the Bay Coal is 11 yards of rock, which contains plants in a bad state of preservation.

Winghay, or	Ctenoptychius apicalis, *Ag.*	Longton
Knowles	Diplodus gibbosus, *Ag.*	Shelton
Coal Shale.	Megalichthys Hibbertii, *Ag.*	
	Teeth with numerous cusps	
	Neuropteris dubia, *Brong.*	

Succeeding these are beds of "Clunch" mixed with shales and rock binds. These overlie the Priorsfield bass (9 yards 1 ft.) which contains in the upper part compressed shells of the genus *Anthracosia.* The lower part contains *Lingula mytiloides*, Sow. Fish remains are not numerous, and occur in fragments.

Brown Mine	Palæoniscus, 2 Sp.	Kidsgrove
Ironstone,	Platysomus, Sp. large	Apedale
1 ft. 8 in.	„ Sp.	Silverdale
	Acanthodus Sp., same as Deep Mine	Golden Hill
	Rhizodus granulatus, *Ag.*	
	„ minor	
	„ lanciformis	
	Megalichthys Hibbertii	
	„ Sp.	
	Ctenoptychius apicalis, *Ag.*	

Measure.	*Name of Fossil.*	*Locality.*
	Diplodus gibbosus, *Ag.*	
	Orthacanthus cylindricus, *Ag.*	
	Gyracanthus formosus	
	„ tuberculatus, *Ag.*	
	Pleuracanthus lævissimus, *Ag.*	
	Ctenodus Sp,, new	
	Leptacanthus longispinus, *Ag.*	
	Ctenacanthus hybodoides, *Eg.*	
	Cytheropsis	
	Anthracosia Sp.	
	Anthracomya Adamsii (at Kidsgrove)	
	„ Phillipsii	
Knowle, or Wingbay Iron-stone 1 ft.	Megalichthys Hibbertii *Ag.*	Fenton
	„ Sp. (two)	
	Rhizodus, 3 species	
	Cœlacanthus lepturus *Ag.*	
	Palæoniscus, 4 species	
	Platysomus, 2 Sp.	
	Gyrolepis Sp.	
	Acanthodus Sp.	
	Diplodus gibbosus *Ag.*	
	„ minutus *Ag.*	
	Ctenoptychius apicalis *Ag.*	
	„ denticulata *Ag.*	
	„ pectinatus *Ag.*	
	Helodus simplex	
	„ Sp.	
	Cladodus Sp.	
	Ctenodus cristatus *Ag.*	
	„ Sp.	
	Gyracanthus formosus *Ag.*	
	„ tuberculata *Ag.*	
	Ctenacanthus hybodoides *Ag.*	
	Orthacanthus cylindricus *Ag.*	
	Leptacanthus longispinus *Ag.*	
	Pleuracanthus lævissimus *Ag.*	
	„ without the serrated edge	
	Anthracomya Adamsii	
	„ subconstricta	
	„ pumila	

Measure.	*Name of Fossil.*	*Locality.*
	Anthracoptera Browniana	
	„ Sp. (three)	
	Anthracosia Sp., like A. Gerrandi	
Gold Mine Ironstone. 2 feet.	Cœlacanthus lepturus, *Ag.*	Silverdale
	Acanthodus Sp.	
	Megalichthys Hibbertii, *Ag.*	
	Diplodus gibbosus, *Ag.*	
	Ctenoptychius apicalis	
	Rhizodus granulatus	
	„ Hibbertii (spines)	
	Anthracosia Phillipsii	
	„ small Sp.	
	2ND OR LOWER THICK MEASURES.	
Billy Ironstone, 9 in.	Palæoniscus Sp.	Berry Hill
	Anthracoptera Sp.	
	Cytheropsis	
Ash or Rowhurst Coal, 7 feet.	Palæoniscus Sp., scales with granulated scales	Longton
	„ Sp.	Fenton
	„ Sp., same as Bay-mine	Burslem
	Platysomus Sp.	Chell
	Cœlacanthus lepturus, *Ag.*	
	Megalichthys Hibbertii, *Ag.*	
	„ Sp.	
	Rhizodus minor, *Ag.*	
	„ granulatus, *Ag.*	
	„ Hibbertii (spines)	
	Diplodus gibbosus, *Ag.*	
	Ctenoptychius apicalis	
	„ pectinatus	
	„ denticulata	
	Cladodus Sp.	
	Teeth with numerous cusps (new)	
	Gyracantbus formosus, *Ag.*	
	„ tuberculatus	
	Helodus simplex	
	„ Sp.	

Measure.	*Name of Fossil.*	*Locality.*
Little mine Coal.	Anthracosia ovalis	
	„ Sp.	
	Anatina-like shell	
	Anthracomya Phillipsii	
	Anthracoptera modiolaris, *Sow.*	
	Cytheropsis	
Burnwood Coal and Ironstone 1 ft. 8 in.	Palæoniscus Sp.	Bucknall
	Platysomus Sp.	Hanley
	Cælacanthus lepturus *Ag.*	Chell
	Rhizodus Sp.	
	Megalichthys Hibbertii	
	Anthracomya Adamsii (fine)	
	Anthracosia aquilina	
	„ Sp.	
Moss Coal 5 ft. 6 in.	Platysomus Sp.	The Lawn
	Palæoniscus Sp.	Longton
	Cælacanthus lepturus *Ag.*	Fenton
	Rhizodus granulatus *Ag.*	
	Acanthodus Sp.	
	Diplodus gibbosus *Ag.*	
	Megalichthys Hibbertii *Ag.*	
	Pleuracanthus lævissimus *Ag.*	
	Anthracosia subconstricta, *Sow.*	
	„ lateralis, *Brown.*	
Yard Coal, 5 ft.	Platysomus Sp.	Weston Coyney
	Palæoniscus Sp.	Longton
	Rhizodus granulatus	Fenton
	Helodus simplex	
	Diplodus gibbosus	
	Gyracanthus formosus	
	Megalichthys Hibbertii	
	Anthracomya Phillipsii	
	Cælacanthus lepturus *Ag.*	
Birches Coal 5 feet. Old Whitfield of Norton.	Helodus simplex, *Ag.*	Mear Hay, Longton
	Megalichthys Hibbertii, *Ag.*	
	Diplodus gibbosus, (teeth and skin)	
	Palæoniscus Sp.	
	Rhizodus granulatus, *Ag.*	

Measure.	*Name of Fossil.*	*Locality.*
Ten-foot Coal	Palæoniscus Sp.	Apedale, Norton
7 ft. 6 in.	Cælacanthus lepturus, *Ag.*	Silverdale
	Platysomus Sp.	Hanley
	Rhizodus granulatus	Kidsgrove
	A bed about 2 feet thick, composed of (at Hanley)	
	Anthracosia aquilina	
	,, Subconstricta	
	,, robusta	
	,, ovalis	
	Anthracoptera Sp.	
	,, Brownii	
	Anthracomya Phillipsii	
Bowling Alley Coal.	Megalichthys Hibbertii, *Ag.*	Hanley
	Anthracosia ovalis	Norton
	Anthracomya Phillipsii	Kidsgrove
	Anthracoptera Sp.	
	Spirorbis carbonarius, *Murch.*	
Holly Lane Coal, 2 ft. 5 in.	Palæoniscus Sp.	Adderley Green
	Cælacanthus lepturus, *Ag.*	
	Rhizodus gibbosus, *Ag.*	
	Megalichthys Hibbertii, *Ag.*	
	Diplodus gibbosus, *Ag.*	
	Gyracanthus formosus, *Ag.*	
	Helodus simplex	
	Anthracosia robusta	
	,, ovalis	
	,, like acuta	
	Anthracomya, like quadrata	
Sparrow Butts, or Hard Mine, 4 ft.	Palæoniscus Sp. 2	Adderley Green
	Cælacanthus lepturus *Ag.*	
	Platysomus Sp.	
	Diplodus gibbosus *Ag.*	
	Rhizodus Hibbertii (spines)	
	,, granulatus *Ag.*	
	,, minor	
	Pleurodus Rankenii *Ag.*	
	Helodus simplex *Ag.*	
	Pæcelodus Sp.	

Measure.	*Name of Fossil.*	*Locality.*
	Anthracosia ovalis	
	„ lateralis	
	„ aquilina, *Sow.*	
	Anthracoptera quadrata, *Sow.*	
	„ carinata	
	Anthracomya modiolaris	
	Spirorbis carbonarius *Murch.*	
	Beyrichia arcuata *Bean.*	
Rider Coal, 6 in.	Palæoniscus Sp.	Silverdale
	Cælacanthus Sp.	Not worked in the
	Diplopterus carbonarius	eastern part of the
	Anthracosia ovalis	Coal-field.
	„ robusta	
Banbury Coal, 4 ft.	Megalichthys Hibbertii *Ag.*	Adderley Green
	Rhizodus Sp.	
	Helodus simplex	
	Diplodus gibbosus *Ag.*	
	Ctenoptychuis apicalis	
	Anthracosia aquilina	
	„ ovalis	
Cockhead Iron-stone, of a nodular character	Gyrolepis, Sp. new, in nodules of Ironstone	Adderley Green
	Acanthodus, Sp. „	
	Cælacanthus lepturus „	
	Rhizodus Sp. „	
	Platysomus Sp.	
	Palæoniscus Sp.	
	Megalichthys Hibbertii, *Ag.*	
	Helodus simplex, *Ag.*	
	Pleurodus Rankenii	
	Pæcelodus Sp.	
	Cladodus Sp.	
	Ctenacanthus hybodoides, *Eg.*	
	Pleuracanthus lævissimus, *Ag.*	
	Anthracosia acuta	
	„ ovalis	
	„ lateralis	
	„ Sp. (two)	

Measure.	*Name of Fossil.*	*Locality.*
	Beyrichia arcuata	
	Spirorbis carbonarius, *Murch.*	
Bullhurst Coal Shale.	Aviculopecten papyraceus	
	Posidonia Gibsonii	
Winpenny	Aviculopecten papyraceus	

4TH, LOWEST MEASURES.

Shales between the 4 ft. and Winpenny.	Aviculopecten papyraceus	Outcrop at Knypersly reservoirs.

Near the 4 foot at Wetley is a band of marine limestone, with fossils.

The lowest measures contain an abundance of *Goniatites* of several species;—one *(Goniatites Bilenguis)* is found in the Millstone grit shales in the Lancashire coal-fields. There are also *Goniatites Listeri, Goniatites paucilobus, Orthoceras sp., Lingula, Anthracosia, &c., &c.*

THE DUDLEY GEOLOGICAL SOCIETY AND THE MECHANICS' INSTITUTION.

As a difference of opinion has arisen between the Committee of the Geological Society and that of the Mechanics' Institution, relative to the interpretation of the agreements entered into between the two Societies, on March 17th, 1863, and May 3rd, 1864; the Committee of the Geological Society think it desirable to lay a detailed statement of the facts of the case before the members of the Society, and the public generally.

The Geological Society was established on July 24th, 1862, and it was proposed to take immediate steps for raising a fund for the purpose of erecting a building suitable for the Society's requirements. Before, however, any definite action was taken in this matter, overtures were received from the Dudley Mechanics' Institution, suggesting the advisability of the Geological Society becoming connected with the Institution. On July 31st, the Secretary of the Institution attended the Committee Meeting of the Geological Society to advocate such a union of interests. The following is our minute relating to this Meeting:—

"Mr. Stokes submitted the plan of the new building for Dudley "Mechanics' Institute, showing the provision which has been made for the "Geological Museum, and it was considered desirable that this Society should "co-operate with the Mechanics' Institution in securing a home for the val-"uable geological collection lying useless in Dudley. It was resolved that "Messrs. Rupert Kettle, R. Bigge, and H. Beckett, be appointed a sub-com-

"mittee to co-operate with the Building Committee of the Mechanics' "Institute, Dudley, in reference to accommodation for the Geological "Museum and for the other purposes of this Society."

A circular was issued by the above sub-committee, appealing for funds, and about £45 was obtained in answer to the appeal. This sum was duly paid over to the Building Fund of the Mechanics' Institute. The following is the list of subscribers:—

	£	s.	d.
B. Gibbons, Esq.	10	10	0
H. Beckett, Esq.	5	0	0
J. Solly, Esq.	5	0	0
Miss Twamley	5	0	0
Mr. Smallman	2	0	0
Mr. T. Turner	1	0	0
Mr. T. Burns	1	0	0
Dr. Wollaston	2	0	0
Mr. Tarratt	1	0	0
Dr. Fraser	1	1	0
Mr. Cooksey	2	2	0
Mr. Jno. Jones	2	2	0
Mr. S. Bailey	3	0	0
Mr. Titus Fellows	1	0	0
Mr. J. U. Fellows	0	5	0
Mr. Cox, (Handsworth)	2	0	0
Rev. F. Willett	0	5	0
	£44	5	0

On Tuesday, March 17th, 1863, a deputation from the Mechanics' Institute Committee met the Committee of the Geological Society, as described in the following extract from the Transactions of the Dudley Geological Society, No. 2:—

A Special Sub-Committee from the Mechanics' Institution attended to confer with the Committee as to the terms on which the two Societies should be affiliated for certain operations, in the new building, when the following regulations were agreed upon:—

1. That the Museum, which is now the property of the former Dudley Geological Society, shall, on its transfer to Trustees, to be hereafter named, be placed and kept in the building now in course of erection in Wolverhampton Street, Dudley, and in that part of the building now marked on the plan as the Museum.

2. That in consideration of the Members of the Dudley and Midland

Geological and Scientific Society and Field Club subscribing to the funds of the new building, they shall have the free use and enjoyment of the said Museum, in common with the Members of the Mechanics' Institute.

3. That the Geological Society shall be responsible for the arrangements of the Museum, and shall appoint a Curator for the same, and shall pay annually to the Mechanics' Institute £5, or such other sum as shall be mutually agreed upon between the two Societies, towards the expenses of cleaning, &c.

4. That any person shall be at liberty to deposit Fossils, Minerals, or other property in the Museum, in any of the following ways:—

a. GIFT TO THE MUSEUM,—In which case the property so deposited shall become the property of the Special Museum Trustees.

b. LOAN TO THE MUSEUM,—In which case the depositors shall be at liberty to take away the property so deposited, at any time, on giving one month's notice, in writing, to the Curator.

c. GIFT TO THE GEOLOGICAL SOCIETY,—In which case the property so deposited shall belong to the Trustees of the Geological Society, and shall remain in the Museum as long as the two Societies are affiliated.

5. That all specimens so deposited in the Museum shall be labelled, and particulars as to the mode in which they are deposited shall be entered in a book to be kept by the Curator for that purpose, and to be signed by the depositor, so that any dispute as to ownership may be prevented.

6. That the Mechanics' Institution shall be at liberty to admit the general public to the Museum upon such terms as they shall think fit.

7. That the Geological Society shall have the free use of one of the small committee rooms as often as they shall require the same.

8. That the Trustees of the Mechanics' Institute shall be at liberty to determine the foregoing agreement by giving to the Trustees of the Geological Society three years' notice, in writing.

It should be stated, that, owing to the agreement entered into with the Geological Society, the Mechanics' Institution was not put to any expense which was not contemplated in the original plans of the building; in fact, not a single alteration was made in those plans on account of the Geological Society. It should also be understood that though the Institution had, in its plans, made arrangements for a spacious Museum, on the assumption that the fossils and other property of the former Dudley Geological Society would be transferred to the Institution, they had no documentary agreement with the Trustees of the Old Society with respect to this transfer, and, therefore, when the present Geological Society came into existence it was quite an open question whether the fossils, &c. would be deposited in the proposed Institution Museum. In the Agreement no specific sum was named as the minimum contribution of the Geological Society to the Building Fund; had

such been the case much more careful scrutiny would have been exercised in regard to the subscriptions, especially in many cases where the subscribers were Members of both Societies, and where the subscriptions would have been apportioned, in certain moieties, to the two Societies, had any such arrangement as above indicated been in existence. From the above agreement and union of the two Societies, the Mechanics' Institution therefore derived directly a sum of £44. towards the Building Fund, together with an additional sum which it is now impossible to estimate, as the subscriptions to the two Societies were merged together. They also secured to themselves a *prestige* by having a Society covering a large area, and occupying a position among the leading Provincial Scientific Societies, connected with it, and thus the Institution assumed a more Metropolitan or district character than it would otherwise have done. They secured the old collection of fossils for the Museum, and the trouble and expense of keeping the Museum in order was taken off their shoulders. The expense of cleaning the Museum was also undertaken by the Geological Society. This the Mechanics' Institution obtained by having the Geological Society affiliated with it; and this was acquired without any expenditure beyond what was originally contemplated. It should also be stated that the Museum, as marked upon the Lithographed Plans of the Building, which were before the Committees when the Agreement was drawn up, extended to the front of the Building. When, however, the partition came to be put up, by which the Museum was to be divided from the School-room, it was placed so as to allow the latter room to extend along the whole frontage of the Building on the first-floor. By this means the Museum was made 23 feet 6 inches by 19 feet 6 inches, less than contemplated in the Agreement; but it was understood the partition should be altered when the Geological Society should require the room. Last Spring the Geological Society expressed their wish to have the partition placed as originally intended. The Institution then stated that such an arrangement would be very inconvenient to them. This led to another meeting of the Committees of the two Societies, and at that time (May 3rd, 1864), the following minutes were entered by one of the Honorary Secretaries, Mr. Hollier, on the books of the Geological Society:—

"A Deputation from the Mechanics' Institution attended by appointment "to confer with the Committee as to the conditions at present existing "between the Institution and the Society, as to the Museum and use of other "rooms required for its Committee and other Meetings,—it being considered "that the present arrangements are not mutually satisfactory, when, after "considerable discussion, it was proposed, that the present arrangement as "regards the power of the Mechanics' Institution to give the Geological "Society three years' notice to discontinue the present arrangement, be done "away with, and a fresh one be entered into between the Mechanics' Institu-

"tion and Geological Society, whereby the latter shall have certain possession "of the use of rooms and Museum for a term of seven years, determinable by "either party giving to the other three years' notice, in writing, to do so. "And, as by the present arrangement, the Geological Society are entitled to "an enlargement of space as to the Museum, by the removal of the present "partition, and the extension of the room to the front as marked upon the "plans of the Building, it was proposed, that upon condition of the opening "in the floor being covered over so as to render that part of its surface avail- "able for the purposes of the Museum, *and the full and free use of the Room "over the Laboratory being granted for the purposes of the Society, when it "may be required*, that the Society will not require the extension of the "Museum Room to the front, as so marked upon the plans, until further "arrangements after the expiration of the first term, but will consent to the "use of the room referred to instead."

The precise modifications in the agreement, as drawn up by the Mechanics' Institution and accepted by the Geological Society, are the following:—

"That so much of the Museum Room as is coloured pink in the annexed plan (and which is now separated from the Museum by a wood partition) be permanently separated from the Museum and added to the School-room as now used; and that the Geological Society be allowed to use the Class-room coloured blue, and marked "N" on the said plan (room over laboratory) for the holding of their meetings, and the keeping of their books, papers, sections, &c., but no other than side or wall cases to be placed in the room, or such as will interfere with the use of the room as *a Class or Chess Room* by the members of the Institution."

"That the term for which the Geological Society are to have the use of the Museum and Class-room be twenty-one years, determinable at any time after the first seven years by a three years' notice."

"The Society not to remove or take away their fossils or property until the end of the term."

"That such parts of the original agreement as are not inconsistent with the foregoing to remain in force."

With reference to the modification of the agreement relative to the duration of the arrangement between the two Societies, it should be stated that this matter was totally distinct from that of exchanging the room over the laboratory for part of the Museum. A misunderstanding arose between the two Societies when the Geological Society ascertained the precise terms of the deed of transfer by which the fossils, &c., belonging to the former Society were placed in the keeping of the Mechanics' Institute, and the Geological Society had no interest in the property. The Geological Society were prepared to take some action in this matter, when it was proposed by the

Mechanics' Institution to extend the duration of the agreement as stated in the modified clauses, so that the Geological Society might in effect have some security that they should have the use of the said property for a reasonable period at least. Hence it will be seen that this part of the agreement was modified on independent grounds. It should also be stated that the Geological Society being quite content with the original agreement as far as regards accommodation, were unwilling to accept the proposition of the Institution relative to the room over the laboratory; but at length consented to the arrangement in order to meet the wishes of the Institution. They gave up superficial space in the front of the building equal to 458 feet, and accepted in lieu of it a room in the remotest part of the Institution, and not easy of access, having a superficial area of 496 feet, being only 38 feet in excess of the part given up in the Museum. They also consented that the Institute should use the room for a class and chess room, and they agreed to place no cases down the centre of the room.

As certain alterations were contemplated, which would affect the approaches to the room in question, the Geological Society did not press for the use of the room. They were surprised, however, to ascertain indirectly, about the end of October, that the Committee of the Institution had resolved to appropriate the said room as a "Social" room, in which bagatelle playing, smoking, and refreshments were to be special features. On behalf of the Geological Society, the Secretary called the attention of the Institution Committee to the terms of the agreement, and requested that nothing should be done which was not clearly indicated in that agreement. At the next meeting of the Committee of the Geological Society, the whole matter was fully discussed, and the following resolution was passed:—

"That the Committee of the Dudley Geological Society, having received information that the Committee of the Mechanics' Institution have decided to appropriate the room over the Laboratory for social purposes, consider such a decision a violation of the agreement existing between the two Societies, and therefore cannot give their consent to the proposed changes."

To this the Committee of the Mechanics' Institution sent the following reply:—

"That this Committee is of opinion that the present arrangement for furnishing and conducting the Class Room, as sanctioned by this Committee, is not a violation of the agreement existing between the Mechanics' Institution and the Geological Society, and they believe, that by mutual concessions little or no inconvenience can arise to either parties in consequence thereof; but if it should hereafter be found that any difficulty occurs, the resolution of the Geological Society shall be re-considered."

To this resolution the Secretary replied by requesting the Committee of the Institution to state when the room would be ready for use by the Geolo-

gical Society, and by again calling attention to the terms of the mutual Agreement entered into between the two Societies.

The Committee of the Institution having again considered the matter at their Meeting, resolved, in answer to the Secretary's letter, "That the Secretary be requested to write and inform the Geological Society in answer to their letter, that the room over the Laboratory has been furnished at the expense of the Institution, and is now ready for the holding of the Meetings of the Geological Society, and the keeping of their books, maps, sections, &c., but that they be respectfully reminded, that no other than side or wall cases be placed in the room, or such as will interfere with the use of the room as a Class or Chess Room by the Members of the Institution."

The notice put out by the Institution relative to the opening of the said room for social purposes was also read, and in this no mention was made that the Geological Society had the right to use the room at all. The Committee having considered the two resolutions of the Institution, and having inspected the fittings introduced into the room, (including a bagatelle table) passed the following resolution:—"That the Committee of the Dudley Geological Society consider the proposed application of the room over the Laboratory for social purposes is incompatible with the use of the said room for scientific purposes, and is contrary to the spirit of the agreement existing between the two Societies; they therefore request the Committee of the Mechanics' Institution either to remove the bagatelle board from the room, and to stay the smoking therein, as contemplated by their announcement, or to provide the Geological Society with another suitable room."

The reply received from the Institution was the following resolution:—"That this Committee is still of opinion that every facility has been given to the Geological Society to use the Chess Room for the holding of their Meetings, &c., and therefore do not see any reason to depart from their former resolution."

Thus ended the communications between the two Societies in connection with this matter.*

The above are the facts of the case which the Committee of the Geological Society wish to lay before the Members of both Societies, and the Public. They maintain that when they consented to the modifications in the agreement they *exchanged* a part of the Museum for the room in question, and hence retained a right to the "full and free" use of it when they required it for the purposes of the Society. The Mechanics' Institution appropriated the room without once inquiring what use the Geological Society wanted to make of it, and further resolved to fit it up for certain purposes not only

* The Resolutions passed at the next Meeting of the Committee are withheld, as steps have recently been taken which will, in all probability, lead to a satisfactory settlement of the matter in dispute.

clearly at variance with the spirit and letter of the agreement, but incompatible with the use of the room for scientific purposes. The Committee consider that it would be unbecoming, to say the least of it, to hold scientific Meetings, and to keep their books of reference, maps, sections, &c., and to transact the Secretarial and other business of the Society in a bagatelle and smoking room, and therefore they decline to sanction such features in any rooms which they have the right to occupy. They may state that they would gladly make arrangements to allow the Members of the Institution the general use of the room in the evening, for the purposes of a "Chess or Class room;" but they are at a loss to conceive how smoking and bagatelle playing can be included in the clear definition of the purposes for which the Institution was to enjoy the use of the room. It has been said that the Geological Society would only require the room once a month, and not always so frequently. On the contrary, the Society would require the use of the room very frequently during the day, for Secretarial purposes. They contemplate regular Geological Classes, which would meet at least *once* each week. They will require the rooms during the year once a week at least for Committee or Sub-Committee Meetings. They will want it once a month for the Meeting of ordinary Members. And the Members of the Society will frequently require the room for the purpose of reading the scientific periodicals taken in, and for consulting books, sections, &c., belonging to the Society. They have held 42 Meetings of various kinds within the walls of the Institution, during the past year, so that leaving out the use of the room as a place of reference and for general purposes of the Society, they would have required the room nearly every week for Meetings alone. But during the year the operations of the Society have become more extensive, and they will want to use their rooms much more frequently than heretofore. When all the above circumstances of the case are carefully considered, the Committee feel assured that the Members generally will fully sanction the proceedings which they have taken in this matter. They feel that they have been only protecting the just rights of the Society, as set forth in the agreements existing between the Mechanics' Institution and this Society:—agreements which they maintain each Society is bound in honour to see carried out in good faith. They wish to work in harmony with the Institution; and if any of the arrangements had not been found satisfactory, no doubt a friendly conference would have set matters right. They trust that it is not too late yet for this particular matter to be adjusted; but in any case they think it due to themselves that they should endeavour to demonstrate that whatever steps they have taken, have been deemed imperative on their part, in order to secure the rights of the Society, as determined by agreement.

An adjourned Meeting of the Committee was held 20th December, 1864. Present Messrs. W. H. Haden, (Chair), Henry Johnson, W. Madeley, T. Brettell, S. Bowkley, C. Gray, H. Burton, and the Secretary.

The following were elected Ordinary Members:—William Mathews, The Leasowes; J. P. Badley, Dudley; Brooke Robinson, Dudley; and S. D. Fereday, Dudley.

The following were elected Field Club Members:—Rev. W. Gover, Saltley Training College; Rev. R. Wall, Brewood; Thomas Sheppard, Dudley; J. Leech, Tipton.

It was Resolved to hold a Public Meeting in Dudley, on January 16th, to take into consideration the arrangements necessary for the proposed reception of the Members of the British Association in September next.

A Report and Balance Sheet were presented by the Committee appointed to conduct the Scientific Exhibition held in April last.

Mr. Johnson and the Secretary were appointed, on behalf of the Society, to go through the Catalogue of Fossils in the Museum, in concert with the Gentlemen named by the Mechanics' Institute.

A Meeting of the Committee was held on January 13th, 1865. Present, Messrs. W. H. Haden, (Chair), S. Allport, Henry Johnson, W. Madeley, H. Burton, S. Bowkley, and the Secretary.

The Secretary reported that W. O. Foster, Esq., M.P., had consented to become a Patron and Ordinary Member of the Society, and was duly elected. J. Chambers, Wolverhampton, was elected a Field Club Member.

The sum of £10 12s. 9d. was received from Mr. Hollier, being balance of account, relative to which several communications had been made at previous Committee Meetings.

It was Resolved that the resolution of June 3rd, 1864, relative to the appointment of Honorary Curator, be rescinded.

DUDLEY FINE ARTS AND SCIENTIFIC EXHIBITION,

HELD APRIL, 1864.

Receipts.

	£	s.	d.
Cash for Admission	136	5	11
DONATIONS:—			
Major Guise	2	0	0
T. Badger, Esq. ..	5	0	0
J. Aston, Esq. ..	5	0	0
Balance	6	14	10
	£155	0	9

Disbursements.

	£	s.	d.
Printing, Advertising and Bill Posting	44	19	8
Carriage, Postage, Travelling Expenses, Secretarial Expenses and Sundries ..	28	5	6
Hire of Loom	20	0	0
„ Tables	2	0	0
„ Public Hall	8	5	0
Vans for moving Pictures ..	10	0	0
Carpenters' Work	6	7	6
Green Baize	4	4	2
Glass	0	12	0
Ironmongery	0	11	4½
Hire of Musical Instruments	5	0	0
Attendants' Wages	11	7	2
Glass Blower	3	0	0
Lithographic Pressman ..	3	0	0
Beer and Refreshments for Men	2	3	0
Blacksmith	0	16	0
Police	2	0	0
Fairy Fountain, &c.	2	9	4½
	£155	0	9

W. MADELEY,
AUDITOR.

SAMUEL MILLS, PRINTER, WOLVERHAMPTON STREET, DUDLEY.