Letters acknowledging publications sent were received from the Royal Academy and Royal Zoological Society at Amsterdam, dated February and October, 1860, and from the Leeds Philosophical and Literary Society, dated October 29, 1861.

Letters transmitting donations for the Library were received from the Royal Academy at Vienna, dated December 28, 1861; from the Royal Academy at Amsterdam, November 15, 1861; the Royal Zoological Society at Amsterdam, August, 1860; the Royal Society at Göttingen, February 12, 1862; Col. Bache, Washington, April 19; and James Lenox, of New York, April 25, 1862.

Donations for the Library were received from the Academies at Buda, Vienna, and Amsterdam; the Societies at St. Gall, Lausanne, Göttingen, Leeds, and Bath; the Royal Society, Royal Institution, Royal Astronomical and Asiatic Societies, and Society of Antiquarians, at London; the Geographical Societies of London and Vienna; the Geological Societies in Vienna, Leeds, and Dublin; the Zoological Society in Amsterdam; M. M. Troyon, of Lausanne; Pierragi, of Paris; James Lenox, of New York; Blanchard & Lea, of Philadelphia, and Col. Hartman Bache.

Dr. Goodwin made some remarks upon the Faculties of the Mind and Causation, which were followed by a general discussion of the subject.

And the Society was adjourned.

Stated Meeting, May 16, 1862.

Present, nineteen members.

Judge SHARSWOOD, Vice-President, in the Chair.

Prof. Roehrig, a lately elected member, was introduced by Mr. Lesley.

A letter, accepting membership, was read from S. F. Dupont, dated Wabash, Port Royal, May 8, 1862.

Letters acknowledging the receipt of publications was received from the New Jersey Historical Society, dated April

28, 1862; the Royal Society of Edinburgh, dated December 21, 1861; the Batavian Society at Rotterdam, dated September 30, 1861; the Boston Library, dated April 15, 1862.

A letter accepting the appointment to prepare an obituary notice of Mr. Justice, was received from A. S. Letchworth, dated Philadelphia, May 12, 1862.

Two letters respecting a communication offered for publication in the Transactions, were received from Dr. F. V. Hayden, dated Washington, April 29, and May 1, 1862.

A letter respecting the Michaux legacy was read from Dr. Wood, dated Paris, April 15, 1862, addressed to Judge King, as chairman of the special committee on that subject.

A letter requesting the librarian to make up a deficiency in the third volume of the Transactions for the Imperial Academy at St. Petersburg, was read from Baron R. Ostensacken, dated Washington, April 30, 1862.

A letter requesting the completion of the set of the Transactions from Volume III onwards (inclusive) for the Royal Institution, and to be placed on the list for the Transactions, was received from the Assistant Secretary and Keeper of the library, Benjamin Vincent, dated Albemarle Street, London, September 12, 1861. The librarian was directed to furnish the Transactions.

Donations for the library were received from the Bureau of Civil Engineers at Paris, the Royal Academy of Edinburgh, the Massachusetts Historical Society, the Franklin Institute, the New Jersey Historical Society, the Managers and Superintendents of the House of Refuge, Deaf and Dumb Institute, State Lunatic Asylum, Pennsylvania School for Feeble-minded Children, James J. Barclay, Ed. C. Jones, C. Sherman, and Joseph Lesley, of Philadelphia, Col. Hartman Bache, and Charles Ellet, Jr., of Washington.

Judge Sharswood announced the death of a member, Mr. Charles J. Ingersoll, at Philadelphia, on the 14th inst., aged 79. Judge Sharswood was appointed to prepare an obituary notice of the deceased.

Dr. Bache announced the death of another member, Dr. George W. Bethune, at Florence, on the 28th of April, aged

57. Dr. Dunglison was appointed to prepare an obituary notice of the deceased.

Mr. Lesley announced the death of a member of the Society, Prof. K. C. Von Leonhard, at Heidelberg, on the 23d of January, 1862, in the 83d year of his age.

A memoir was presented for the Transactions by Dr. Hayden, and referred to a committee, consisting of Dr. Leidy, Prof. Lesley, and Dr. Roehrig.

Prof. Lesley exhibited a manuscript map of the Alleghany Mountains on a large scale, and described especially the coal formation of Southern Virginia. He remarked that:

The coal region of Montgomery, Pulaski, Wythe, Washington, and Smith counties in Southern Virginia, is interesting in an economical as well as a geological sense. It furnishes species of semi-anthracite and semi-bituminous coal, which come in competition with the Oolitic bituminous coal of the Richmond basin, over the principal internal railroad of the Southern Atlantic States. This railroad penetrates the great primary range of mountains, the Blue Ridge, at Lynchburg, and then follows the course of the Great Valley, southwestward, to Knoxville and Chattanooga, in Eastern Tennessee. This Great Valley, of Lower Silurian limestone, extends from Newburg on the Hudson to Montgomery in Alabama, everywhere separating the range of the Blue Ridge, South Mountain, Smoky Mountain, or Black Hills, from the true Alleghanies or Appalachians. The rocks of the Blue Ridge Range, on the eastern side of the Valley, are a prolongation of the Green Mountains of Vermont, and consist of the Quebec group or Taconic system, now understood by Logan to be a thickening of the lowest Silurians (Calciferous Sandrock and Potsdam Sandstone or Primal Slates).* The Appalachian Mountains on its western side are Middle and Upper Silurian and Devonian formations. West of these rises the long high escarpment of the Carboniferous formation, forming the mountain plateau of Western Pennsylvania, Western Virginia, Eastern Kentucky, Central Tennessee, and Northern Alabama. The escarpment of this vast plateau, facing the east, and overlooking the Appalachian ranges, with their narrow, parallel, interval valleys, is the so-called Backbone Alleghany

* It is but just to say that the Rogerses maintained substantially this view before 1840, considering, as they did, the Blue Ridge System an enlargement merely of Formation No. I.

Mountain, beginning at Catskill on the Hudson, and ending in Alabama. The northern portion of this plateau is drained eastward by the branches of the Susquehanna, and westward by the branches of the Alleghany and Monongahela Rivers. All the waters of Middle Pennsylvania, Maryland, and Northern and Middle Virginia flow from the foot of this escarpment towards the Atlantic, breaking successively through the parallel Appalachian ridges of the subcarboniferous formations. The waters of the Tennessee River head also at the eastern foot of this escarpment, and flow along at its base for several hundred miles southwestward, before they turn west at Chattanooga, and break through its southern extremity, to make their great circuit through Alabama, Western Tennessee, and Kentucky to the Ohio River near its mouth. But in the middle of the region, namely, in Southern Virginia, its normal drainage is reversed. The New River heads in the Blue Range, crosses the Great Valley westward, breaks *into* (not *out of*) the Appalachians, striking the escarpment in its face, and flowing directly through and across it (as the Great Kanawha) through Western Virginia into the Ohio.

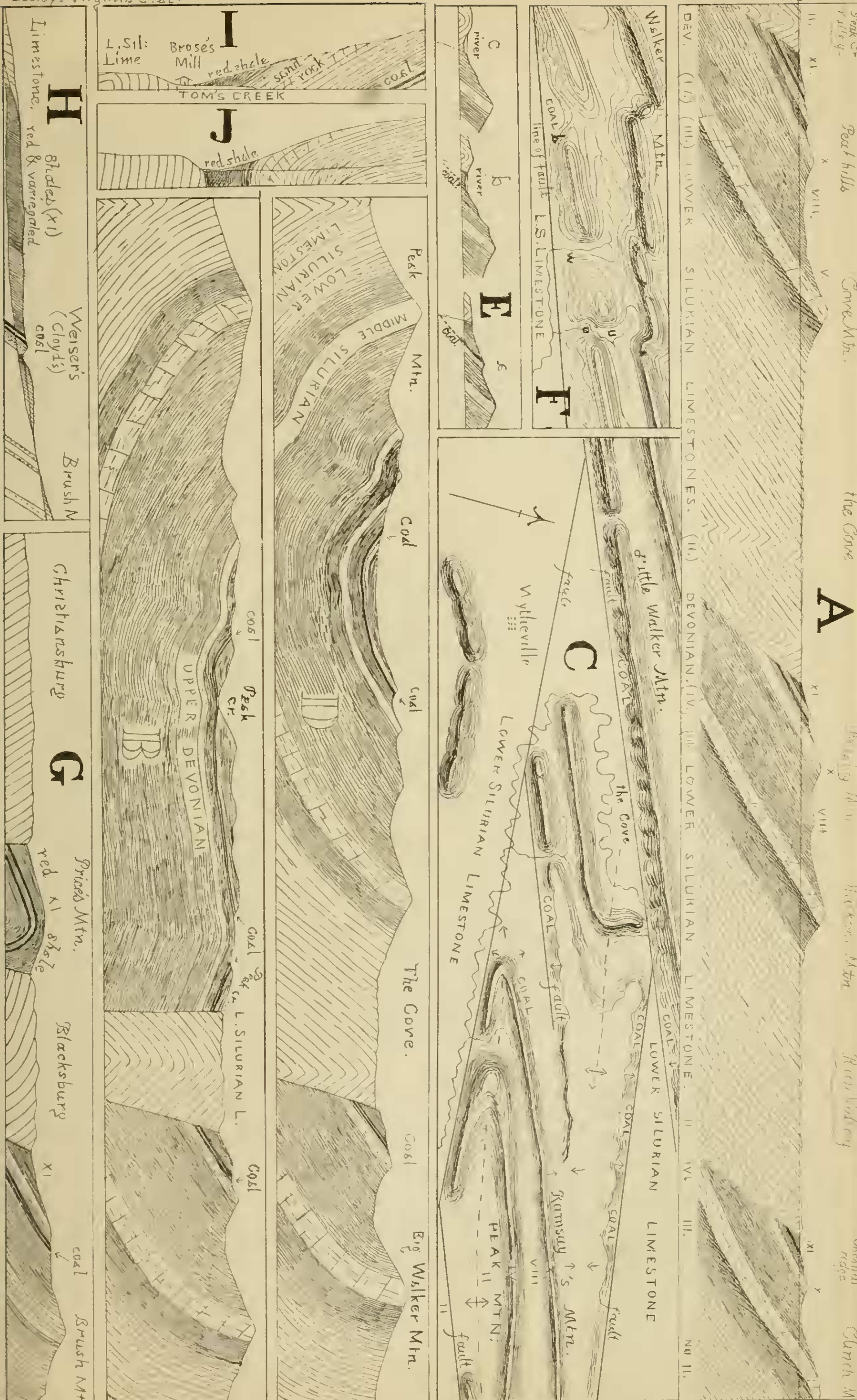
The cause of this phenomenon is to be found in a change of structure at this line. Most of the valleys and mountains north of it as far as New Jersey are unbroken anticlinals and synclinals. Most of the valleys and mountains to the south of it, as far as Alabama, are monoclinals, bounded by immense faults or downthrows.

The Appalachian Mountains of Southern Virginia and Eastern Tennessee are grouped in pairs by these faults. The country for three or four hundred miles northeast and southwest, and from thirty to forty miles from southeast to northwest, is fractured in parallel strips from five to six miles wide. Each strip is tilted at such an angle (dipping southeast) that at each fault the upper edge of one strip (with its Carboniferous rocks) abuts against the bottom or Lower Silurian edge of the strip next to it. As the Palæozoic system, thus revealed (on edge) between any two of these faults, contains two massive sandrock formations, No. IV, Middle Silurian, and No. X, Upper Devonian, there occur necessarily between each pair of faults a pair of parallel mountains. The Palæozoic zone, therefore, included between the Great Valley and the Backbone escarpment, is occupied by as many pairs of parallel mountains as there are great parallel faults; and as these faults range in straight lines at nearly equal distances from each other, these mountains run with remarkable uniformity, side by side, for a hundred or two hundred miles, and are finally cut off, either by short cross faults, or by slight angular changes in the courses of the great faults. Thus we get an explanation of the very unusual arrangement of the head waters of the Tennessee River, in long parallel branches, with few subordinate affluents, suddenly uniting through mountain gorges, or at the ends of long mountains.

In each pair of Palæozoic mountains the eastern one carries a coal area on its seaward flank; because, the last formation to dip against each fault is the Coal at the top of the series, abutting against the Lower Silurian of the limestone valley which always exists on the eastern side of the fault; as seen in the accompanying diagram, representing a section made across three pairs of mountains just north of Wythe. (See Fig. A.)

The coal here represented, however, is not the coal of the Carboniferous formation, commonly so called.

Underneath the true coal measures of Pennsylvania, Ohio, and Northwestern Virginia, and underneath the Millstone Grit Conglomerate (No. XII) at its base, and the Red Shale formation (No. XI), which underlies the last, there begins, even in Pennsylvania, to appear an older coal formation, connected with the uppermost Devonian, white, mountain Sandstone, No. X. It is seen in one or two beds two feet thick at the head waters of the Juniata. It is mined where the Monongahela waters cut through Chestnut Ridge from Virginia into Western Pennsylvania. It has been mined in the mountains on the Potomac *below* Cumberland. It appears occasionally in Northern Middle Virginia, on the western side of the Great Valley of Winchester. It increases in importance along the western outcrop of the great coal field through Eastern Kentucky, until it enters Tennessee. It seems, however, to attain its maximum development in Montgomery county, on the New River, in Southern Virginia, near the line of our section. Here it is seen to consist of two principal coal-beds and several minor seams. The lowest bed reaches the thickness of four feet, and the next one above it is in some places nine feet thick. In the Peak Hills, just east of Wythe, along the line of the railroad, numerous lenticular deposits of coal are seen, and thin distorted beds, the whole composing a formation several hundred feet thick. Near the New River, the two beds above-mentioned are seen to be covered by at least a thousand feet of Red shale; upon which rests a Subcarboniferous limestone; which abuts, at the fault, against other limestones belonging to the Lower Silurian age. Between Christiansburg and Blacktown, north of New River, a regular synclinal coal-basin has been preserved for a few miles upon the eastern side of the great fault, which crosses the river in front of the gap. In this coal-basin the two beds of coal are preserved, but in a crushed condition. To the southwest, two faults cut off a similar short basin from the regular


A
DEV. (IV.) (III.) LOWER SILURIAN LIMESTONES. (II.) DEVONIAN. (IV.) (II.) LOWER SILURIAN LIMESTONE. II. IVL. III. No II.
Peak hills
Cove Mtn.
the Cove
Brushy Mtn
Rich ridge
Clinch M
C
Little Walker Mtn.
Wytheville
the Cove
LOWER SILURIAN LIMESTONE
Ramsay's Mtn.
PEAK MTN.
fault
COAL
E
river
coal
F
Walker Mtn.
line of fault
L.S. LIMESTONE
Peak Mtn.
LOWER SILURIAN LIMESTONE
MIDDLE SILURIAN
Coal
D
The Cove.
Big Walker Mtn.
UPPER DEVONIAN
B
Peak Cr.
L. SILURIAN L.
I
L. Sil. Lime
Brose's Mill
red shale
sand rock
coal
TOM'S CREEK
J
red shale
H
Limestone.
Shales (XI) red & variegated
Weiser's (Cloyd's) coal
Brush M
G
Christiansburg
Price's Mtn.
red XI shale
Blacksburg
coal
Brush Mt

coal formation on the mountain, throwing up a wedge of Lower Silurian Limestone, as in the section, Fig. B.

It is here that the relationship of these great faults to the normal anticlinals and synclinals of the Appalachian region can be studied to great advantage; the presence of cross faults at high angles being exhibited by the sudden termination of the mountains, and by the tearing open, as it were, of one side of anticlinal coves. The sketch of the topography north of Wytheville, in Fig. C., will show how this has been effected, and render further description needless.

The straitness of the mountains is sometimes interfered with by small cross undulations or faults (it is not easy to determine which they are), producing offsets and minute coves, notches, and sometimes gaps, as seen in Fig. F, representing a portion of the first pair of mountains west of Wytheville.

The "plaster banks" of the Holston, are deposits of rock salt and gypsum and red marl, in excavations along faults, two of which are transverse, and one parallel to the main fault, at the foot of the Little Clinch Mountain. Over this main fault the river flows, probably burying the outcrop of the coal, although it is possible that the fault itself may here have cut out the coal, see Figs. E, *b* and *c*. Fig. E, *a*, represents the coal, and the fault further east.

These gypsum deposits have no geological connection with the coal, however the analogy of the Michigan subcarboniferous gypsum and salt, and of the Nova Scotia gypsum deposits, might seem at first glance to suggest one. They are found along the valley for sixteen miles, but the principal deposit occupies the excavated axis of a broken anticlinal, in the lowest part of the Lower Silurian limestone. The plain of the Salt Works was once a triangular lake, scooped out of the soft, reddish sulphur-iron rocks of the base of the Palæozoic system, lifted to the surface by an anticlinal, terminated at its east or northeast end by a cross fracture, which lets the usual hard limestones of the valley settle down on the other side of it into their ordinary posture against the main fault. No plaster occurs above water-level. The Upper Banks occupy a cross fracture; and borings here, 500 feet deep, bring up salt water. At the Middle Banks, seven miles east of the Salt Works, the deposit seems to be on the line of the main fault. A mile from the Salt Works, it is dug on the small cross fault. At the Salt Works, the borings go down along the snap of the anticlinal, through 60 to 80 feet of plaster and red clay.

The decomposition of the sulphurets in these red rocks, have converted the outcrop edges of the limestone, as well as the limestone clays and lime waters of the inflowings of the valley, into gypsum. There must have been standing pools along these excavated faults, or no deposits of solid gypsum and rock salt could have occurred. And the want of such, in other parts of this and the neighboring valleys has prevented similar deposits, especially in the great valley east of Wythe, where these lowest red rocks, with their sulphuret ores of iron and lead, appear at the surface in great force; and large quantities of these ores have been converted into peroxide of iron and carbonate of lead; no doubt by the loss of sulphuric acid, gone to produce gypsum, which has been carried off by the free drainage of the country. None of the main parallel faults of the back valleys, seem to bring these red rocks to the surface, except along the Holston; and even here, it required the crushing of the surface rocks along a supplementary anticlinal, to afford facilities, first for excavation, and then for decomposition.

It is possible, of course, that sulphur waters, issuing upwards along the line of the anticlinal and cross faults, may have assisted in the process; but there is no need to call in their assistance to explain the phenomenon, and such springs now are wanting elsewhere. On the other hand, masses of sulphuret of iron, inclosed in workable limonite ore, may be seen along the line, at Carleton Hill, twenty miles east of the Salt Works, and three miles east of large deposits of limonite ore of workable quality.

To account for the rock salt several hundred feet below the gypsum, seems more difficult. It lies in solid form, mixed and interstratified with compact red marl or clay, 200 feet below water-level; and the borings have gone down 176 feet further without reaching the bottom. Into this deep lake, the drainage of the Upper Devonian sandstones on one side of the fault, as well as of the Lower Silurian limestones on the other, must have always run and deposited their salt with mud and sand. But on top of the deposits of salt and mud was thrown down a stratum of blue slate more than a hundred feet thick; and over this again, the 60 to 80 feet of gypseous clays, until the lake was full. All this looks much more like a chemical than a mechanical precipitation.

The present connection of the mass of gypsum, mud, and salt with the Holston River, through underground crevices beneath the ridge of limestone which separates them, is apparent from the fact that water in all the wells not only always stands at the same level, but at the level of the river; nor does the heaviest pumping alter it.

The lower gypsum banks (Preston's) yielded in 1854, 2000 tons;

the cost at the mines being $3 per lump and $5 for ground plaster; eighty miles distant it has been sold for $20.

The yield in salt in 1853 was 300,000 bushels; 50 pounds to the bushel, and 6 bushels to the barrel, at 50 cents per bushel. Five furnaces were then running, and 24,000 gallons of brine pumped daily; 10,000 cords of wood supplied the fuel. Coal is now used, brought from the neighborhood of Wytheville by a branch railroad.

Southwest of Wythe, the coal is traceable in all the little ravines and gaps of the first mountain west of the Great Valley; and in the third mountain west of it, far beyond the celebrated salt deposit of Smith county, and into Tennessee; but the single bed is thin and crushed, and the coal worthless. In the Peak Hills country, east of Wythe, the coal is almost an anthracite, and has been exposed to such movements that it rattles like sand out of the shovel, and cannot, therefore, go to market. Otherwise it is pure and good. This condition is apparently connected with the appearance of a massive sand-rock under it, which forms a terrace and range of small peaks along the side of the mountain. The coal bed itself is of large size, consisting of the following layers:

Roof shale, sandy, several feet.
Coal dirt and coal slate, ... 5 feet.
Yellow shale, two feet.
Coal crushed to coarse dust, ... 2 feet.
Blue shale, &c., three feet.
Coal crushed and coal slate, ... 2 feet.
Interval of twenty or thirty feet.
Quarry rock.

On the south side of the New River the two coal beds are opened at Cloyd's. Here the summit and mid-rib of the Brushy Mountain is a pebbly conglomerate of great thickness, dipping 45° south 34° east; over which, forming the southeastern slope of the mountain, are, first, yellowish flagstones; and then, soft clay slates; in all about 1200 feet thick, dipping the same way. Over these lies the "Quarry rock," a massive, gray, micaceous, quartzose sandstone, forming a line of little peaks. Ten feet above this is coal bed A, yielding about two feet of very bright pure semi-anthracite coal, much crushed and with the same dip. Thirty-five feet above A lies coal bed B, with its neat, undisturbed roof-rock of thin-bedded argillaceous sandstone, yielding about two and a half feet of good coal out of the following section:

	FEET.	INCHES.
Coal, good,		10
—— slate,	1	0
Coal, poor,	1	2
Coal, crushed and slate,		6
Coal, poor,		6
Coal, crushed and slate,	2	6
Coal, good,	1	10
Coal, good,		9—in all 9.1.

An outcrop of black slate seems to represent the place of a third bed of coal, about 50 feet above coal B. About 550 feet still higher, the red shales set in and continue for many hundred feet, all at the same dip of about 45°, with great regularity, until limestones appear just at the fault. This section is represented in Fig. H.

On the northeast side of New River, where it enters the gap, a minor fault, in the opposite direction, has downthrown the coal of the mountain, so as to cause the outcrop of coal A to disappear, with steep mountain dips. But coal B shows four feet of good solid coal, with five feet of slaty coal on top. (See Fig. D.)

At Poverty Gap, further east, both beds appear with a dip of about 17°⌋ south 13° east, 45 feet apart; A yielding 3 feet of excellent coal, and B eight feet thick, slaty and crushed on top, soft and sandy in the middle, and hard, fine, blacksmith coal 3 feet at the bottom. Cliffs of compact green sandstone, 40 feet high, tower over the gangway, and introduce (going east) a new feature in the vertical section. Here is observable the curious variety called "sand-coal;" rightly named, for it feels to the hand as if sanded over, but is apparently as pure and good as the rest.

At Brose's mill, still further east, the great fault can be distinctly seen, where the red shale over the cliff sandstone dips 30°⌋ southward, directly against the vertical Lower Silurian Limestone of the valley. At Knode's crossing, further east, the red shale side of the fault has been curved down so as to produce a plunge of red shale against the fault at an angle of 60°–70°. (See Figs. I. and J.)

At Millstone hollow (still going east), A yields 2.6 of good coal, and, 20 feet above it, B (under its cliffs) shows the following section:

	FEET.	INCHES.
Soft coal,		8
Slate and coal,	4	0
Soft coal,		10
Slate,	1	3
Coal,	3	0