directions, the paramount influence of this "facility of production" should still be apparent as the one cause which determines the general aspect of the system.

The causes I have mentioned would obviously determine an unequal growth of the system and preclude a perfectly symmetrical arrangement, at any given time of observation, of the cluster of hydrocarbons around the axial line. How far this inequality is due to accidental causes, and how far to the operation of permanent causes acting in one direction, is impossible, from the slender data we possess, to say, but the chemist should ever be alive to the detection of permanent deviations, in the form of the actual system, from the form indicated by theory, for in such observations lie our best means of detecting the existence of other causes affecting its growth, besides that predominant cause which has been here discussed.

January 31, 1878.

Sir JOSEPH HOOKER, K.C.S.I., President in the Chair.

The Presents received were laid on the table and thanks ordered for them.

The following papers were read:—

I. "Further Researches on the Minute Structure of the Thyroid Gland." Preliminary Communication. By E. Cresswell Baber, M.B. Lond. Communicated by Dr. Klein, F.R.S. Received November 21, 1877.

In a previous communication to the Society* I have described some observations made on the minute anatomy of the thyroid gland of the dog. Since then I have extended these observations, under the direction of Dr. Klein, to the glands of other vertebrate animals. The chief results as yet arrived at will be very shortly described in the present communication, a full account of them being reserved to a future paper.

Lymphatics.—In the thyroid gland of the dog I have described a dense rounded network of lymphatics traversing the gland in all directions, and consisting of lymphatic vessels, tubes, and spaces. A similar system of lymphatics has been observed in the glands of other mammalia, as kitten, rabbit, man, and horse; the extent of distribution, however, as shown by the injection, appears to vary in different

* "Philosophical Transactions," 1876, vol. clxvi, pt. ii, p. 557.

Brodie.

MAP OF THE SYSTEM OF HYDROCARBON

1 1	K 1	K^2 1	K^3 1	K^4 1	K^5 1	K^6 1	K^7 1	K^8 1	K^9 1	K^{10} 1	K^{11} 1	K^{12} 1	K^{13} 1	K^{14} 1
α^1 1	αK 2	αK^2 3	αK^3 4	αK^4 5	αK^5 6	αK^6 7	αK^7 8	αK^8 9	αK^9 10	αK^{10} 11	αK^{11} 12	αK^{12} 13	αK^{13} 14	αK^{14} 15
α^2 1	$\alpha^2 K$ 3	$\alpha^2 K^2$ 6	$\alpha^2 K^3$ 10	$\alpha^2 K^4$ 15	$\alpha^2 K^5$ 21	$\alpha^2 K^6$ 28	$\alpha^2 K^7$ 36	$\alpha^2 K^8$ 45	$\alpha^2 K^9$ 55	$\alpha^2 K^{10}$ 66	$\alpha^2 K^{11}$ 78	$\alpha^2 K^{12}$ 91	$\alpha^2 K^{13}$ 105	$\alpha^2 K^{14}$ 120
α^3 1	$\alpha^3 K$ 4	$\alpha^3 K^2$ 10	$\alpha^3 K^3$ 20	$\alpha^3 K^4$ 35	$\alpha^3 K^5$ 56	$\alpha^3 K^6$ 84	$\alpha^3 K^7$ 120	$\alpha^3 K^8$ 165	$\alpha^3 K^9$ 220	$\alpha^3 K^{10}$ 286	$\alpha^3 K^{11}$ 364	$\alpha^3 K^{12}$ 455	$\alpha^3 K^{13}$ 560	$\alpha^3 K^{14}$ 680
α^4 1	$\alpha^4 K$ 5	$\alpha^4 K^2$ 15	$\alpha^4 K^3$ 35	$\alpha^4 K^4$ 70	$\alpha^4 K^5$ 126	$\alpha^4 K^6$ 210	$\alpha^4 K^7$ 330	$\alpha^4 K^8$ 495	$\alpha^4 K^9$ 715	$\alpha^4 K^{10}$ 1001	$\alpha^4 K^{11}$ 1365	$\alpha^4 K^{12}$ 1820	$\alpha^4 K^{13}$ 2380	$\alpha^4 K^{14}$ 3060
α^5 1	$\alpha^5 K$ 6	$\alpha^5 K^2$ 21	$\alpha^5 K^3$ 56	$\alpha^5 K^4$ 126	$\alpha^5 K^5$ 252	$\alpha^5 K^6$ 462	$\alpha^5 K^7$ 792	$\alpha^5 K^8$ 1287	$\alpha^5 K^9$ 2002	$\alpha^5 K^{10}$ 3003	$\alpha^5 K^{11}$ 4368	$\alpha^5 K^{12}$ 6188	$\alpha^5 K^{13}$ 8568	$\alpha^5 K^{14}$
α^6 1	$\alpha^6 K$ 7	$\alpha^6 K^2$ 28	$\alpha^6 K^3$ 84	$\alpha^6 K^4$ 210	$\alpha^6 K^5$ 462	$\alpha^6 K^6$ 924	$\alpha^6 K^7$ 1716	$\alpha^6 K^8$ 3003	$\alpha^6 K^9$ 5005	$\alpha^6 K^{10}$ 8008	$\alpha^6 K^{11}$ 12376	$\alpha^6 K^{12}$ 18564	$\alpha^6 K^{13}$	$\alpha^6 K^{14}$
α^7 1	$\alpha^7 K$ 8	$\alpha^7 K^2$ 36	$\alpha^7 K^3$ 120	$\alpha^7 K^4$ 330	$\alpha^7 K^5$ 792	$\alpha^7 K^6$ 1716	$\alpha^7 K^7$ 3432	$\alpha^7 K^8$ 5435	$\alpha^7 K^9$ 11440	$\alpha^7 K^{10}$ 19448	$\alpha^7 K^{11}$ 31824			$\alpha^7 K^{14}$
α^8 1	$\alpha^8 K$ 9	$\alpha^8 K^2$ 45	$\alpha^8 K^3$ 165	$\alpha^8 K^4$ 495	$\alpha^8 K^5$ 1287	$\alpha^8 K^6$ 3003	$\alpha^8 K^7$ 6435	$\alpha^8 K^8$ 12870	$\alpha^8 K^9$ 24310	$\alpha^8 K^{10}$ 43758	$\alpha^8 K^{11}$			$\alpha^8 K^{14}$
α^9 1	$\alpha^9 K$ 10	$\alpha^9 K^2$ 55	$\alpha^9 K^3$ 220	$\alpha^9 K^4$ 715	$\alpha^9 K^5$ 2002	$\alpha^9 K^6$ 5005	$\alpha^9 K^7$ 11440	$\alpha^9 K^8$ 24310	$\alpha^9 K^9$ 48620	$\alpha^9 K^{10}$				
α^{10} 1	$\alpha^{10} K$ 11	$\alpha^{10} K^2$ 66	$\alpha^{10} K^3$ 286	$\alpha^{10} K^4$ 1001	$\alpha^{10} K^5$ 3003	$\alpha^{10} K^6$ 8008	$\alpha^{10} K^7$ 19448	$\alpha^{10} K^8$ 43758	$\alpha^{10} K^9$	$\alpha^{10} K^{10}$				
α^{11} 1	$\alpha^{11} K$ 12	$\alpha^{11} K^2$ 78	$\alpha^{11} K^3$ 364	$\alpha^{11} K^4$ 1365	$\alpha^{11} K^5$ 4368	$\alpha^{11} K^6$ 12376	$\alpha^{11} K^7$ 31824			$\alpha^{11} K^{10}$				
α^{12} 1	$\alpha^{12} K$ 13	$\alpha^{12} K^2$ 91	$\alpha^{12} K^3$ 455	$\alpha^{12} K^4$ 1820	$\alpha^{12} K^5$ 6188	$\alpha^{12} K^6$ 18564					$\alpha^{12} K^{11}$			
α^{13} 1	$\alpha^{13} K$ 14	$\alpha^{13} K^2$ 105	$\alpha^{13} K^3$ 560	$\alpha^{13} K^4$ 2380	$\alpha^{13} K^5$ 8568							$\alpha^{13} K^{12}$		
α^{14} 1	$\alpha^{14} K$ 15	$\alpha^{14} K^2$ 120	$\alpha^{14} K^3$ 680	$\alpha^{14} K^4$ 3060									$\alpha^{14} K^{13}$	
α^{15} 1	$\alpha^{15} K$ 16	$\alpha^{15} K^2$ 136	$\alpha^{15} K^3$ 816											$\alpha^{15} K^{14}$
α^{16} 1	$\alpha^{16} K$ 17	$\alpha^{16} K^2$ 153												
α^{17} 1	$\alpha^{17} K$ 18													
α^{18} 1														

ON

3	K^{14} 1	K^{15} 1	K^{16} 1	K^{17} 1	K^{18} 1
13	αK^{14} 15	αK^{15} 16	αK^{16} 17	αK^{17} 18	
13	$\alpha^2 K^{14}$ 120	$\alpha^2 K^{15}$ 136	$\alpha^2 K^{16}$ 153		
13	$\alpha^3 K^{14}$ 680	$\alpha^3 K^{15}$ 816			
13)	$\alpha^4 K^{14}$ 3060				
13 8	$\alpha^5 K^{14}$		$\alpha^5 K^{16}$		
13	$\alpha^6 K^{14}$	$\alpha^6 K^{15}$	$\alpha^6 K^{16}$		$\alpha^6 K^{18}$
	$\alpha^7 K^{14}$		$\alpha^7 K^{16}$	$\alpha^7 K^{17}$	
	$\alpha^8 K^{14}$	$\alpha^8 K^{15}$			
			$\alpha^9 K^{16}$		$\alpha^9 K^{18}$
13		$\alpha^{14} K^{15}$			
	$\alpha^{15} K^{14}$	$\alpha^{15} K^{15}$	$\alpha^{15} K^{16}$		
		$\alpha^{16} K^{15}$	$\alpha^{16} K^{16}$		
			$\alpha^{17} K^{16}$		

W. West & Co. lith.

animals. In the *tortoise* a network of lymphatics can be injected, of which the smaller ramifications run between almost all individual vesicles. The homogeneous or granular material which I have described in the lymphatics of the dog's thyroid, has been observed in the same vessels in other thyroid glands, *e.g.*, in those of horse, man, sheep. It occurs in both injected and uninjected glands. The quantity varies much in different glands of the same animal, it being sometimes present in large quantities, and at other times appearing to be entirely absent. These observations so far merely confirm the results arrived at in the dog. In the thyroid gland of *birds*, however, a different arrangement of parts takes place. On injecting the thyroid gland of a pigeon by the method of puncture with Berlin blue, it becomes swollen, and the injection is seen running *in the jugular vein*, with which the gland is in close apposition.* Examination of sections of the gland shows that the injection has entered vessels containing blood-corpuscles. The same vessels become filled on injecting in like manner with nitrate-of-silver solution. To ascertain whether by the puncture method the blood-vessels really become injected, another gland was injected with Berlin blue from the lower part of the carotid artery, the artery at the same time being secured above the gland. In this case, in which the injection had entered the capillaries and veins, it was evident that these were the same system of vessels which were injected by the method of puncture. I may, therefore, state that on repeated injections of the thyroid gland of the pigeon, both with Berlin blue solution and with nitrate of silver by the method of puncture, *I have been unable to inject any system of lymphatic vessels, but have always found the injection in the blood-vessels of the gland.* In the thyroid gland of this bird the blood-vessels present the following characters:—The capillaries, as usual, form a network running between the individual gland-vesicles, but in proportion to the size of the vesicles (which in this gland are as a rule small), they do not appear so minute, nor to have such complicated ramifications as in the case of mammalia, but resemble more the distribution of the lymphatics in some of those animals. The veins frequently surround, either partially or entirely, the arteries which they accompany. Immediately under the capsule of the gland numerous large veins are seen, and in the fibrous capsule itself, I have noticed layers of blood-corpuscles, which appear to be contained in blood-vessels communicating with the veins of the interior. Once or twice I have noticed in the large veins on the surface of the gland (under the capsule), in addition to blood-corpuscles, and perhaps coloured injection, a greater or less quantity of a material of homogeneous aspect, presenting an appearance similar to the material seen

* It will be remembered that on injecting the dog's thyroid gland in a similar manner, the injection was seen emerging from the gland *in lymphatic vessels* which ran to neighbouring lymphatic glands.

in the vesicles, and also to that described above in the lymphatics of the thyroid gland of the dog and other mammalia. In the thyroid gland of the *rook* no system of lymphatics is injected by the method of puncture, but the blood-vessels, presenting an appearance very similar to those in the pigeon, become filled. Since the publication of my researches on the thyroid gland of the dog, I have become acquainted with P. A. Boéchat's thesis on the structure of the thyroid gland (published in 1873), in which he describes the lymphatics of this organ. I regret that I was not previously aware of his researches, but it is satisfactory to find that the results of our independent observations on this subject are very similar.

Epithelial Cells.—In the thyroid gland of several animals I have observed in the epithelial cells *numerous very fine parallel striæ*, running in the direction of the long axis of the cell, *i.e.*, from the summit (or free extremity) of the cell down towards its base. I can sometimes trace this striation running apparently the whole length of the cell from apex to base; at other times it is only visible for a greater or less distance near the summit of the cell. I have observed it most clearly in the thyroid glands of the skate, tortoise, pigeon, and kitten. Between the epithelial cells of the thyroid gland a *reticulum* may often be observed. I have noticed it more especially in the tortoise, skate, kitten, &c. Recently Otto Zeiss * has described a reticulum between the epithelial cells of the thyroid gland.

Parenchyma.—The large round cells described in my previous paper in the thyroid gland of the adult dog, and there named "parenchymatous cells," I have since observed in dogs aged five and nine weeks respectively. In the thyroid gland of the *cat* parenchymatous cells are present in considerable numbers, although not nearly so numerous as in the dog. Parenchymatous cells are also seen in the thyroid of the *rabbit*. In the thyroid gland of the *pigeon* large groups are frequently seen consisting of cells, which are larger than the adjacent epithelial cells, round or oval in shape, and provided each with a single spherical or oval-shaped nucleus. They resemble very much the parenchymatous cells seen in the dog.

Undeveloped Portions.—In the thyroid gland of the *adult dog* bodies of considerable size are frequently seen, which differ entirely in structure from the rest of the gland. They are rounded or flattened in shape, usually situate on the surface of the organ, and possess the following structure. They consist of a solid mass of more or less *cylindrical rows of cells*, which are much convoluted and interlace in all directions. Between them run capillary blood-vessels, and also probably some lymphatics. These "cylinders" are composed of cells resembling epithelial cells, columnar or cubical in shape, those on the surface of the

* "Mikroskopische Untersuchungen über den Bau der Schilddrüse." Strassburg, 1877.

cylinder, next to the capillaries, being arranged at right angles to the long axis of those vessels. Each cell is provided with a nucleus, usually oval in shape. In very few, if in any, of these cylinders have I been able to detect any central canal. In the dog I have always observed these "undeveloped portions" as distinct bodies, not continuous with the normal gland tissue, but separated from it by layers of connective tissue, and frequently lying in depressions on the surface of the gland. They appear to be portions of gland, whose development has become arrested at an early stage, and there is no evidence to show that they undergo any further development subsequently.

In the *kitten* similar undeveloped portions are seen, but in this animal they may sometimes be observed to be continuous with the ordinary gland tissue. In this case a formation of vesicles from the cylinders of cells appears to be taking place by the growth into them laterally of processes of connective tissue with blood vessels, and by their excavation into vesicles. In the kitten the cylinders are less convoluted than in the dog, and throughout the gland the fully formed vesicles frequently appear grouped in rows, which have a more or less parallel arrangement. Somewhat similar, but shorter, cylinders of cells are seen in the thyroid of the *pigeon*, scattered throughout the gland. I may mention that in the thyroid glands of fœtal pigs (measuring about 2¼ inches in length) before the formation of vesicles has taken place, I have seen cylinders presenting an appearance similar to those above described.

In sections of the glands of young dogs (aged about five weeks and three months respectively) I have observed that the vesicles are very much branched, and present numerous hollow ramifications. In the thyroid glands of numerous other dogs of different ages, I have with equal certainty ascertained that the vesicles presented very few, if any, of these hollow branches. These much-branched vesicles are doubtless the hollow branched cavities (tubes) of Zeiss, which he obtains by floating them out from portions of the fresh gland of young animals. In glands in which the vesicles present this appearance, the walls of the vesicles are frequently inflexed so as to form numerous projections into the interior, as already described by Verson and myself. Zeiss has repeatedly endeavoured to inject these hollow-branched cavities by the method of puncture, but without success. Neither have I, in all my injections, ever succeeded in filling any such structures, which must surely have been the case if the hollow-branched cavities were in communication with one another to any extent, for it seems almost impossible to suppose, as Zeiss does, that the contents of these cavities can prevent the injection from running into them, whilst we know that the viscid contents of the lymphatics have no such effect. I am of opinion that these hollow branched cavities do not communicate with one another to any extent, and that, in the dog at least, they merely

form a stage in the growth of the gland. In the mature state of the organ in this animal I consider that the vesicles, as usually supposed, consist of cavities more or less spherical in shape, which are not in communication with one another.

The points mentioned in this note, together with others connected with the subject, will be fully discussed in a future paper.

II. "On Stratified Discharges. V. Discharge from a Condenser of Large Capacity." By WILLIAM SPOTTISWOODE, M.A., LL.D., Treas. and V.P.R.S. Received November 22, 1877.

The principal object of the following communication is to describe an instrumental arrangement which has proved very convenient for the production of steady striæ. The first attempt which was made nearly two years ago (February, 1876), consisted in charging a Leyden battery of nine large jars by means of an induction coil, and discharging it gradually through a vacuum tube. This was effected by connecting one terminal of the tube with the outside of the battery, and presenting the other terminal, made pointed, to a knob connected with the inside, at suitable distances. The following effects were then observed:

(1.) When the interval between the terminal and the knob was considerably greater than striking distance, the appearance in the tube was cloudy and apparently unstratified, or showed only faint indications of stratification. It was, in fact, very similar to that produced by attaching one terminal of the tube to one of an induction coil, and carrying the other to the earth.

(2.) When the interval was within striking distance, the usual jar-discharge without stratification or dark space took place.

(3.) When the interval was slightly greater than striking distance, but not so great as in the first case, a bright stratified discharge was observed. The proper motion due to a decline in tension was shown by a revolving mirror, and by a careful but rapid alteration in the distance during discharge, the motion could be arrested or even reversed. The duration of the whole, although long compared with a single flash from an ordinary coil, did not exceed half a second.

This experiment gave reason to hope that if a condenser of sufficient capacity were constructed, the discharge might be prolonged, and even varied, so as to allow an actual study of its various phases to be made.

The next attempt was made during last summer with some condensing plates, constructed for cable purposes, and kindly lent to me by Messrs. Latimer Clark, Muirhead, and Co. The results were in every way calculated to encourage further steps.

At the suggestion of Mr. De la Rue, and with the assistance of his

MAP OF THE SYSTEM OF HYDROCARBON

1 1	K 1	K^{2} 1	K^{3} 1	K^{4} 1	K^{5} 1	K^{6} 1	K^{7} 1	K^{8} 1	K^{9} 1	K^{10} 1	K^{11} 1	K^{12} 1	K^{13} 1	K^{14} 1	K^{15} 1	K^{16} 1	K^{17} 1	K^{18} 1
α^{1} 1	αK 2	αK^{2} 3	αK^{3} 4	αK^{4} 5	αK^{5} 6	αK^{6} 7	αK^{7} 8	αK^{8} 9	αK^{9} 10	αK^{10} 11	αK^{11} 12	αK^{12} 13	αK^{13} 14	αK^{14} 15	αK^{15} 16	αK^{16} 17	αK^{17} 18	
α^{2} 1	$\alpha^{2}K$ 3	$\alpha^{2}K^{2}$ 6	$\alpha^{2}K^{3}$ 10	$\alpha^{2}K^{4}$ 15	$\alpha^{2}K^{5}$ 21	$\alpha^{2}K^{6}$ 28	$\alpha^{2}K^{7}$ 36	$\alpha^{2}K^{8}$ 45	$\alpha^{2}K^{9}$ 55	$\alpha^{2}K^{10}$ 66	$\alpha^{2}K^{11}$ 78	$\alpha^{2}K^{12}$ 91	$\alpha^{2}K^{13}$ 105	$\alpha^{2}K^{14}$ 120	$\alpha^{2}K^{15}$ 136	$\alpha^{2}K^{16}$ 153		
α^{3} 1	$\alpha^{3}K$ 4	$\alpha^{3}K^{2}$ 10	$\alpha^{3}K^{3}$ 20	$\alpha^{3}K^{4}$ 35	$\alpha^{3}K^{5}$ 56	$\alpha^{3}K^{6}$ 84	$\alpha^{3}K^{7}$ 120	$\alpha^{3}K^{8}$ 165	$\alpha^{3}K^{9}$ 220	$\alpha^{3}K^{10}$ 286	$\alpha^{3}K^{11}$ 364	$\alpha^{3}K^{12}$ 455	$\alpha^{3}K^{13}$ 560	$\alpha^{3}K^{14}$ 680	$\alpha^{3}K^{15}$ 816			
α^{4} 1	$\alpha^{4}K$ 5	$\alpha^{4}K^{2}$ 15	$\alpha^{4}K^{3}$ 35	$\alpha^{4}K^{4}$ 70	$\alpha^{4}K^{5}$ 126	$\alpha^{4}K^{6}$ 210	$\alpha^{4}K^{7}$ 330	$\alpha^{4}K^{8}$ 495	$\alpha^{4}K^{9}$ 715	$\alpha^{4}K^{10}$ 1001	$\alpha^{4}K^{11}$ 1365	$\alpha^{4}K^{12}$ 1820	$\alpha^{4}K^{13}$ 2380	$\alpha^{4}K^{14}$ 3060				
α^{5} 1	$\alpha^{5}K$ 6	$\alpha^{5}K^{2}$ 21	$\alpha^{5}K^{3}$ 56	$\alpha^{5}K^{4}$ 126	$\alpha^{5}K^{5}$ 252	$\alpha^{5}K^{6}$ 462	$\alpha^{5}K^{7}$ 792	$\alpha^{5}K^{8}$ 1287	$\alpha^{5}K^{9}$ 2002	$\alpha^{5}K^{10}$ 3003	$\alpha^{5}K^{11}$ 4368	$\alpha^{5}K^{12}$ 6188	$\alpha^{5}K^{13}$ 8568	$\alpha^{5}K^{14}$		$\alpha^{5}K^{16}$		
α^{6} 1	$\alpha^{6}K$ 7	$\alpha^{6}K^{2}$ 28	$\alpha^{6}K^{3}$ 84	$\alpha^{6}K^{4}$ 210	$\alpha^{6}K^{5}$ 462	$\alpha^{6}K^{6}$ 924	$\alpha^{6}K^{7}$ 1716	$\alpha^{6}K^{8}$ 3003	$\alpha^{6}K^{9}$ 5005	$\alpha^{6}K^{10}$ 8008	$\alpha^{6}K^{11}$ 12376	$\alpha^{6}K^{12}$ 18564	$\alpha^{6}K^{13}$	$\alpha^{6}K^{14}$	$\alpha^{6}K^{15}$	$\alpha^{6}K^{16}$		$\alpha^{6}K^{18}$
α^{7} 1	$\alpha^{7}K$ 8	$\alpha^{7}K^{2}$ 36	$\alpha^{7}K^{3}$ 120	$\alpha^{7}K^{4}$ 330	$\alpha^{7}K^{5}$ 792	$\alpha^{7}K^{6}$ 1716	$\alpha^{7}K^{7}$ 3432	$\alpha^{7}K^{8}$ 6435	$\alpha^{7}K^{9}$ 11440	$\alpha^{7}K^{10}$ 19448	$\alpha^{7}K^{11}$ 31824	^		$\alpha^{7}K^{14}$		$\alpha^{7}K^{16}$	$\alpha^{7}K^{17}$	
α^{8} 1	$\alpha^{8}K$ 9	$\alpha^{8}K^{2}$ 45	$\alpha^{8}K^{3}$ 165	$\alpha^{8}K^{4}$ 495	$\alpha^{8}K^{5}$ 1287	$\alpha^{8}K^{6}$ 3003	$\alpha^{8}K^{7}$ 6435	$\alpha^{8}K^{8}$ 12870	$\alpha^{8}K^{9}$ 24310	$\alpha^{8}K^{10}$ 43758	$\alpha^{8}K^{11}$			$\alpha^{8}K^{14}$	$\alpha^{8}K^{15}$			
α^{9} 1	$\alpha^{9}K$ 10	$\alpha^{9}K^{2}$ 55	$\alpha^{9}K^{3}$ 220	$\alpha^{9}K^{4}$ 715	$\alpha^{9}K^{5}$ 2002	$\alpha^{9}K^{6}$ 5005	$\alpha^{9}K^{7}$ 11440	$\alpha^{9}K^{8}$ 24310	$\alpha^{9}K^{9}$ 48620	$\alpha^{9}K^{10}$						$\alpha^{9}K^{16}$		$\alpha^{9}K^{18}$
α^{10} 1	$\alpha^{10}K$ 11	$\alpha^{10}K^{2}$ 66	$\alpha^{10}K^{3}$ 286	$\alpha^{10}K^{4}$ 1001	$\alpha^{10}K^{5}$ 3003	$\alpha^{10}K^{6}$ 8008	$\alpha^{10}K^{7}$ 19448	$\alpha^{10}K^{8}$ 43758	$\alpha^{10}K^{9}$	$\alpha^{10}K^{10}$								
α^{11} 1	$\alpha^{11}K$ 12	$\alpha^{11}K^{2}$ 78	$\alpha^{11}K^{3}$ 364	$\alpha^{11}K^{4}$ 1365	$\alpha^{11}K^{5}$ 4368	$\alpha^{11}K^{6}$ 12376	$\alpha^{11}K^{7}$ 31824			$\alpha^{11}K^{10}$								
α^{12} 1	$\alpha^{12}K$ 13	$\alpha^{12}K^{2}$ 91	$\alpha^{12}K^{3}$ 455	$\alpha^{12}K^{4}$ 1820	$\alpha^{12}K^{5}$ 6188	$\alpha^{12}K^{6}$ 18564					$\alpha^{12}K^{11}$							
α^{13} 1	$\alpha^{13}K$ 14	$\alpha^{13}K^{2}$ 105	$\alpha^{13}K^{3}$ 560	$\alpha^{13}K^{4}$ 2380	$\alpha^{13}K^{5}$ 8568							$\alpha^{13}K^{12}$						
α^{14} 1	$\alpha^{14}K$ 15	$\alpha^{14}K^{2}$ 120	$\alpha^{14}K^{3}$ 680	$\alpha^{14}K^{4}$ 3060									$\alpha^{14}K^{13}$		$\alpha^{14}K^{15}$			
α^{15} 1	$\alpha^{15}K$ 16	$\alpha^{15}K^{2}$ 136	$\alpha^{15}K^{3}$ 816											$\alpha^{15}K^{14}$	$\alpha^{15}K^{15}$	$\alpha^{15}K^{16}$		
α^{16} 1	$\alpha^{16}K$ 17	$\alpha^{16}K^{2}$ 153													$\alpha^{16}K^{15}$	$\alpha^{16}K^{16}$		
α^{17} 1	$\alpha^{17}K$ 18															$\alpha^{17}K^{16}$		
α^{18} 1																		

W. West & Co. lith.

Brodie.

MAP OF THE SYSTEM OF HYDROCARBON

1	K 1	K^2 1	K^3 1	K^4 1	K^5 1	K^6 1	K^7 1	K^8 1	K^9 1	K^{10} 1	K^{11} 1	K^{12} 1	K^{13} 1	K^{14} 1
α^1 1	αK 2	αK^2 3	αK^3 4	αK^4 5	αK^5 6	αK^6 7	αK^7 8	αK^8 9	αK^9 10	αK^{10} 11	αK^{11} 12	αK^{12} 13	αK^{13} 14	αK^{14} 15
α^2 1	$\alpha^2 K$ 3	$\alpha^2 K^2$ 6	$\alpha^2 K^3$ 10	$\alpha^2 K^4$ 15	$\alpha^2 K^5$ 21	$\alpha^2 K^6$ 28	$\alpha^2 K^7$ 36	$\alpha^2 K^8$ 45	$\alpha^2 K^9$ 55	$\alpha^2 K^{10}$ 66	$\alpha^2 K^{11}$ 78	$\alpha^2 K^{12}$ 91	$\alpha^2 K^{13}$ 105	$\alpha^2 K^{14}$ 120
α^3 1	$\alpha^3 K$ 4	$\alpha^3 K^2$ 10	$\alpha^3 K^3$ 20	$\alpha^3 K^4$ 35	$\alpha^3 K^5$ 56	$\alpha^3 K^6$ 84	$\alpha^3 K^7$ 120	$\alpha^3 K^8$ 165	$\alpha^3 K^9$ 220	$\alpha^3 K^{10}$ 286	$\alpha^3 K^{11}$ 364	$\alpha^3 K^{12}$ 455	$\alpha^3 K^{13}$ 560	$\alpha^3 K^{14}$ 680
α^4 1	$\alpha^4 K$ 5	$\alpha^4 K^2$ 15	$\alpha^4 K^3$ 35	$\alpha^4 K^4$ 70	$\alpha^4 K^5$ 126	$\alpha^4 K^6$ 210	$\alpha^4 K^7$ 330	$\alpha^4 K^8$ 495	$\alpha^4 K^9$ 715	$\alpha^4 K^{10}$ 1001	$\alpha^4 K^{11}$ 1365	$\alpha^4 K^{12}$ 1820	$\alpha^4 K^{13}$ 2380	$\alpha^4 K^{14}$ 3060
α^5 1	$\alpha^5 K$ 6	$\alpha^5 K^2$ 21	$\alpha^5 K^3$ 56	$\alpha^5 K^4$ 126	$\alpha^5 K^5$ 252	$\alpha^5 K^6$ 462	$\alpha^5 K^7$ 792	$\alpha^5 K^8$ 1287	$\alpha^5 K^9$ 2002	$\alpha^5 K^{10}$ 3003	$\alpha^5 K^{11}$ 4368	$\alpha^5 K^{12}$ 6188	$\alpha^5 K^{13}$ 8568	$\alpha^5 K^{14}$
α^6 1	$\alpha^6 K$ 7	$\alpha^6 K^2$ 28	$\alpha^6 K^3$ 84	$\alpha^6 K^4$ 210	$\alpha^6 K^5$ 462	$\alpha^6 K^6$ 924	$\alpha^6 K^7$ 1716	$\alpha^6 K^8$ 3003	$\alpha^6 K^9$ 5005	$\alpha^6 K^{10}$ 8008	$\alpha^6 K^{11}$ 12376	$\alpha^6 K^{12}$ 18564	$\alpha^6 K^{13}$	$\alpha^6 K^{14}$
α^7 1	$\alpha^7 K$ 8	$\alpha^7 K^2$ 36	$\alpha^7 K^3$ 120	$\alpha^7 K^4$ 330	$\alpha^7 K^5$ 792	$\alpha^7 K^6$ 1716	$\alpha^7 K^7$ 3432	$\alpha^7 K^8$ 6435	$\alpha^7 K^9$ 11440	$\alpha^7 K^{10}$ 19448	$\alpha^7 K^{11}$ 31824			$\alpha^7 K^{14}$
α^8 1	$\alpha^8 K$ 9	$\alpha^8 K^2$ 45	$\alpha^8 K^3$ 165	$\alpha^8 K^4$ 495	$\alpha^8 K^5$ 1287	$\alpha^8 K^6$ 3003	$\alpha^8 K^7$ 6435	$\alpha^8 K^8$ 12870	$\alpha^8 K^9$ 24310	$\alpha^8 K^{10}$ 43758	$\alpha^8 K^{11}$			$\alpha^8 K^{14}$
α^9 1	$\alpha^9 K$ 10	$\alpha^9 K^2$ 55	$\alpha^9 K^3$ 220	$\alpha^9 K^4$ 715	$\alpha^9 K^5$ 2002	$\alpha^9 K^6$ 5005	$\alpha^9 K^7$ 11440	$\alpha^9 K^8$ 24310	$\alpha^9 K^9$ 48620	$\alpha^9 K^{10}$				
α^{10} 1	$\alpha^{10} K$ 11	$\alpha^{10} K^2$ 66	$\alpha^{10} K^3$ 286	$\alpha^{10} K^4$ 1001	$\alpha^{10} K^5$ 3003	$\alpha^{10} K^6$ 8008	$\alpha^{10} K^7$ 19448	$\alpha^{10} K^8$ 43758	$\alpha^{10} K^9$	$\alpha^{10} K^{10}$				
α^{11} 1	$\alpha^{11} K$ 12	$\alpha^{11} K^2$ 78	$\alpha^{11} K^3$ 364	$\alpha^{11} K^4$ 1365	$\alpha^{11} K^5$ 4368	$\alpha^{11} K^6$ 12376	$\alpha^{11} K^7$ 31824			$\alpha^{11} K^{10}$				
α^{12} 1	$\alpha^{12} K$ 13	$\alpha^{12} K^2$ 91	$\alpha^{12} K^3$ 455	$\alpha^{12} K^4$ 1820	$\alpha^{12} K^5$ 6188	$\alpha^{12} K^6$ 18564					$\alpha^{12} K^{11}$			
α^{13} 1	$\alpha^{13} K$ 14	$\alpha^{13} K^2$ 105	$\alpha^{13} K^3$ 560	$\alpha^{13} K^4$ 2380	$\alpha^{13} K^5$ 8568							$\alpha^{13} K^{12}$		
α^{14} 1	$\alpha^{14} K$ 15	$\alpha^{14} K^2$ 120	$\alpha^{14} K^3$ 680	$\alpha^{14} K^4$ 3060									$\alpha^{14} K^{13}$	
α^{15} 1	$\alpha^{15} K$ 16	$\alpha^{15} K^2$ 136	$\alpha^{15} K^3$ 816											$\alpha^{15} K^{14}$
α^{16} 1	$\alpha^{16} K$ 17	$\alpha^{16} K^2$ 153												
α^{17} 1	$\alpha^{17} K$ 18													
α^{18} 1														

ON

	K^{14} 1	K^{15} 1	K^{16} 1	K^{17} 1	K^{18} 1
3	αK^{14} 15	αK^{15} 16	αK^{16} 17	αK^{17} 18	
8	$\alpha^2 K^{14}$ 120	$\alpha^2 K^{15}$ 136	$\alpha^2 K^{16}$ 153		
13	$\alpha^3 K^{14}$ 680	$\alpha^3 K^{15}$ 816			
13	$\alpha^4 K^{14}$ 3060				
13	$\alpha^5 K^{14}$		$\alpha^5 K^{16}$		
8	$\alpha^6 K^{14}$	$\alpha^6 K^{15}$	$\alpha^6 K^{16}$		$\alpha^6 K^{18}$
	$\alpha^7 K^{14}$		$\alpha^7 K^{16}$	$\alpha^7 K^{17}$	
	$\alpha^8 K^{14}$	$\alpha^8 K^{15}$			
			$\alpha^9 K^{16}$		$\alpha^9 K^{18}$
13		$\alpha^{14} K^{15}$			
	$\alpha^{15} K^{14}$	$\alpha^{15} K^{15}$	$\alpha^{15} K^{16}$		
		$\alpha^{16} K^{15}$	$\alpha^{16} K^{16}$		
			$\alpha^{17} K^{16}$		

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