



우주와 생명 제 2강

유전물질

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INTRODUCTION

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J. Expt. Med. 79, 137 (1944)



<출처>

http://www.chemistryexplained.com/images/chfa_01_img0106.jpg

폐렴균의 형질 변환을 유도하는 물질의 화학적 본성 연구

Studies on the Chemical Nature of the Substance
Inducing Transformation of Pneumococcal Types

에이버리, 맥레오드, 맥카티
Avery, MacLeod, McCarty

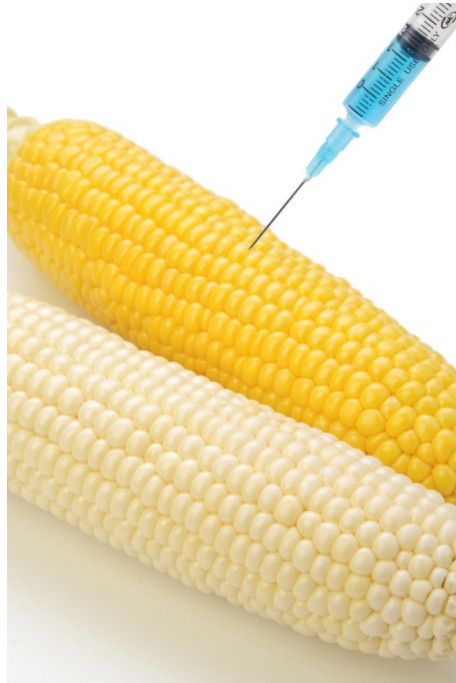
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2-1 유전적 형질 변환(Genetic Transformation)

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생물학자들은 오랫동안 화학적 방법을 통해 고등생물에서 예측가능하고 특정한, 그리고 유전적 특성으로 대대로 전달될 수 있는 변화를 유도하려고 시도해왔다.



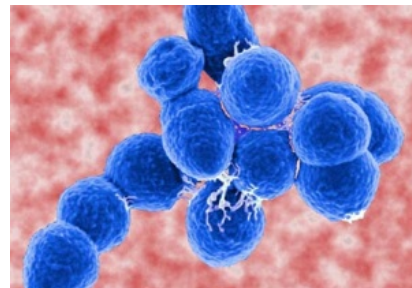
Biologists have long attempted by chemical means to induce in higher organisms predictable and specific changes which thereafter could be transmitted in series as hereditary characters.

2-1 유전적 형질 변환(Genetic Transformation)

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미생물 중에서 실험적으로 유도될 수 있으며, 잘 정의되고 적절히 조절된 조건 하에서 재현성 있게 세포의 구조와 기능이 바뀌고 유전되는 특정한 변이의 가장 놀라운 예는 특정한 종류의 폐렴균의 변이에서 찾아볼 수 있다.

Among microorganisms the most striking example of inheritable and specific alterations in cell structure and function that can be experimentally induced and are reproducible under well defined and adequately controlled conditions is the transformation of specific types of Pneumococcus.

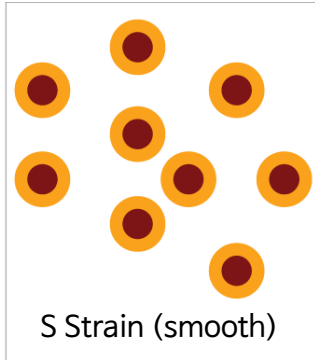
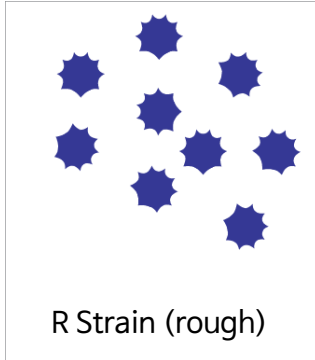


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https://cnho.files.wordpress.com/2010/11/streptococcus_20pneumoniae.jpg

2-2 그리피스의 실험(Griffith's Experiment)

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이 현상은 그리피스가 처음 기술했는데, 그는 하나의 특정한 종에서 유도된 크기가 작고 피막이 없는 R(rough) 타입의 변종을 제대로 된 피막이 있고 병을 일으킬 수 있는 S(smooth) 타입의 특정한 다른 종으로 바꾸는데 성공했다.

This phenomenon was first described by Griffith who succeeded in transforming an attenuated and non-encapsulated (R) variant derived from one specific type into fully encapsulated and virulent (S) cells of a heterologous specific type.

2-2 그리피스의 실험(Griffith's Experiment)

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그리피스는 소량의 타입 II 폐렴균에서 유도된 살아있는 R 배양균을 다량의 고온에서 살균된 타입 III S 세포로 접종해서 쥐에게 피하 주사하면 쥐가 종종 감염되어 죽고, 이 죽은 쥐 심장의 피를 배양하면 타입 III 폐렴균이 발견된다는 것을 알아냈다.



Frederick Griffith
1928

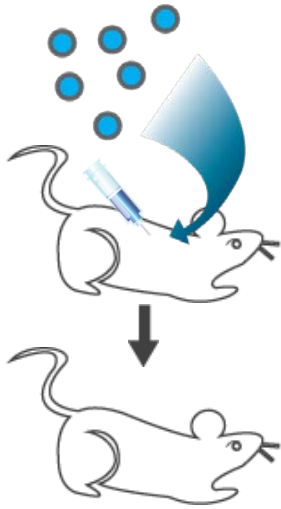
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http://keepinapbiologyreal.wikispaces.com/file/view/to_wikispaces_griffith.jpg/199323320/to_wikispaces_griffith.jpg

Griffith found that mice injected subcutaneously with a small amount of a living R culture derived from *Pneumococcus* Type II together with a large inoculum of heat-killed Type III (S) cells frequently succumbed to infection, and that the heart's blood of these animals yielded Type III pneumococci in pure culture.

2-2 그리피스의 실험(Griffith's Experiment)

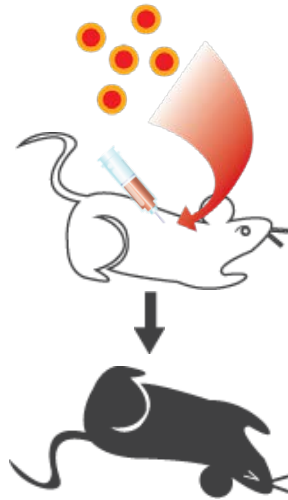
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rough strain
(nonvirulent)



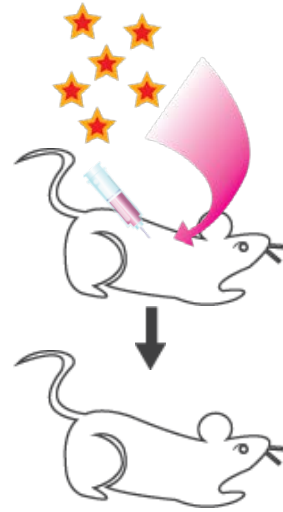
mouse lives

smooth strain
(virulent)



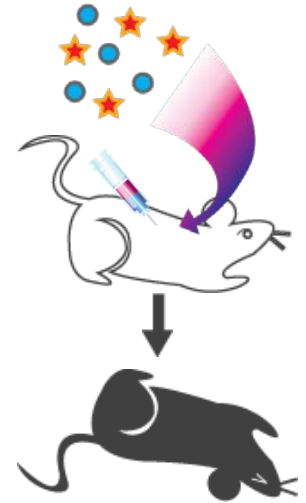
mouse dies

heat-killed
smooth strain



mouse lives

rough strain &
heat-killed
smooth strain



mouse dies

2-3 원소 분석(Elemental Analysis)

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순수하게 정제한 (형질변환인자)
시료의 질소, 인, 탄소, 그리고 수소
함량을 네 차례에 걸쳐 분석했다.

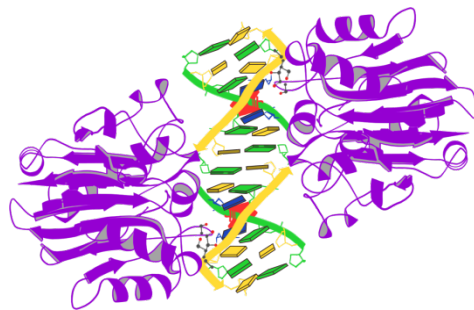
Four purified preparations were
analyzed for content of nitrogen,
phosphorus, carbon, and hydrogen.

	C	H	N	P	N/P ratio
	34.27	3.89	14.21	8.57	1.66
	--	--	15.93	9.09	1.75
	35.50	3.76	15.36	9.04	1.69
	--	--	13.40	8.45	1.58
Theory	34.20	3.21	15.32	9.05	1.69

2-4 DNA 분해 효소(DNase)

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DNA 분해 효소에 의해서만 형질변환인자가 파괴된다는 사실은 활성인자가 디옥시라이보즈 타입의 핵산이라는 확실한 증거가 된다.



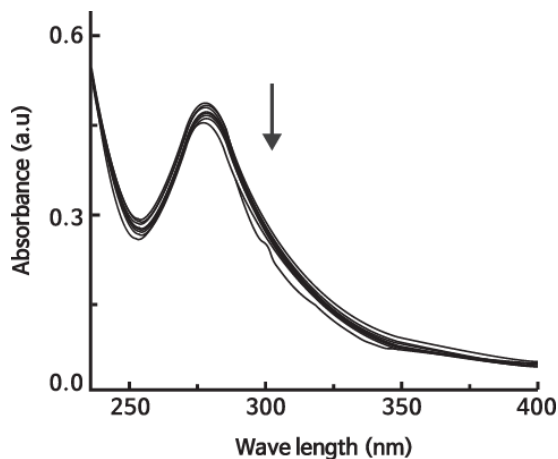
DNase

The fact that transforming activity is destroyed by these preparations containing depolymerase for desoxyribonucleic acid provide evidence for the belief that the active principle is a nucleic acid of the desoxyribose type.

2-5 자외선 스펙트럼(Ultraviolet Spectrum)

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자외선 흡수 곡선은
2600 옹스트롬
부근에서 최대를,
2350 옹스트롬
부근에서 최소를
나타냈다. 이러한
결과는 핵산의 특징이다.

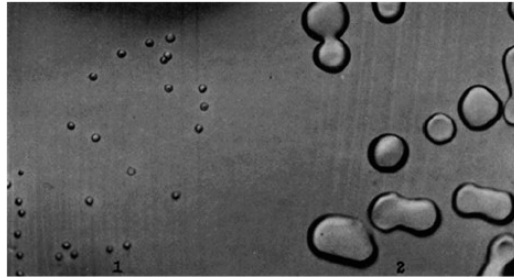


Ultraviolet absorption curves showed maxima in the region of 2600 Å and minima in the region of 2350 Å. These findings are characteristic of nucleic acids.

2-6 항체반응(Antibody Reaction)

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이러한 현상의 배후에 있는 생화학적 사실들은 변환인자가 R 세포와 상호작용하여 일련의 효소 반응들이 차례로 일어나 궁극적으로 타입 III 피막 항원을 합성한다는 것을 시사한다.



The transformation: This plate from Avery's 1944 paper shows the dramatic change associated with transformation from 'rough' (and avirulent) type II cells (left), to 'smooth', virulent type III cells (right). (Reproduced from The Journal of Experimental Medicine, 1944; 79:137-158, by copyright permission of The Rockefeller University Press.)

<출처>

Oswald T. Avery 외(2007), Studies on the Chemical Nature of the Substance Inducing Transformation of Pneumococcal Types, R&A©sonance

The biochemical events underlying the phenomenon suggest that the transforming principle interacts with the R cell giving rise to a coordinated series of enzymatic reactions that culminate in the synthesis of the Type III capsular antigen.

2-7 허쉬의 실험(Hershey's Experiment)

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Hershey, Chase - 1952
blender experiment

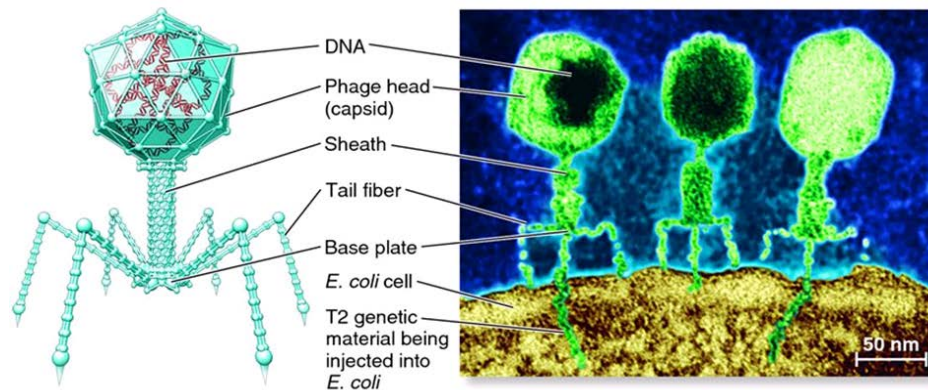
1969년 노벨 생리의학상



<출처>

https://www.dnalc.org/content/c16/16406/16406_hershey_chase.jpg

bacteriophage



(a) Schematic drawing of T2 bacteriophage

(b) An electron micrograph of T2 bacteriophage infecting *E. coli*

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http://biology-forums.com/gallery/33_23_06_11_4_11_12.jpeg

Review

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The great composer Händel
And the great scientist Mendel
Both came from an ancestor common
Over an eon
As a result of biological evolution
Taking place through natural selection.



Georg Händel
(1685-1759)



Gregor Mendel
(1822-1884)



Charles Darwin
(1809-1882)