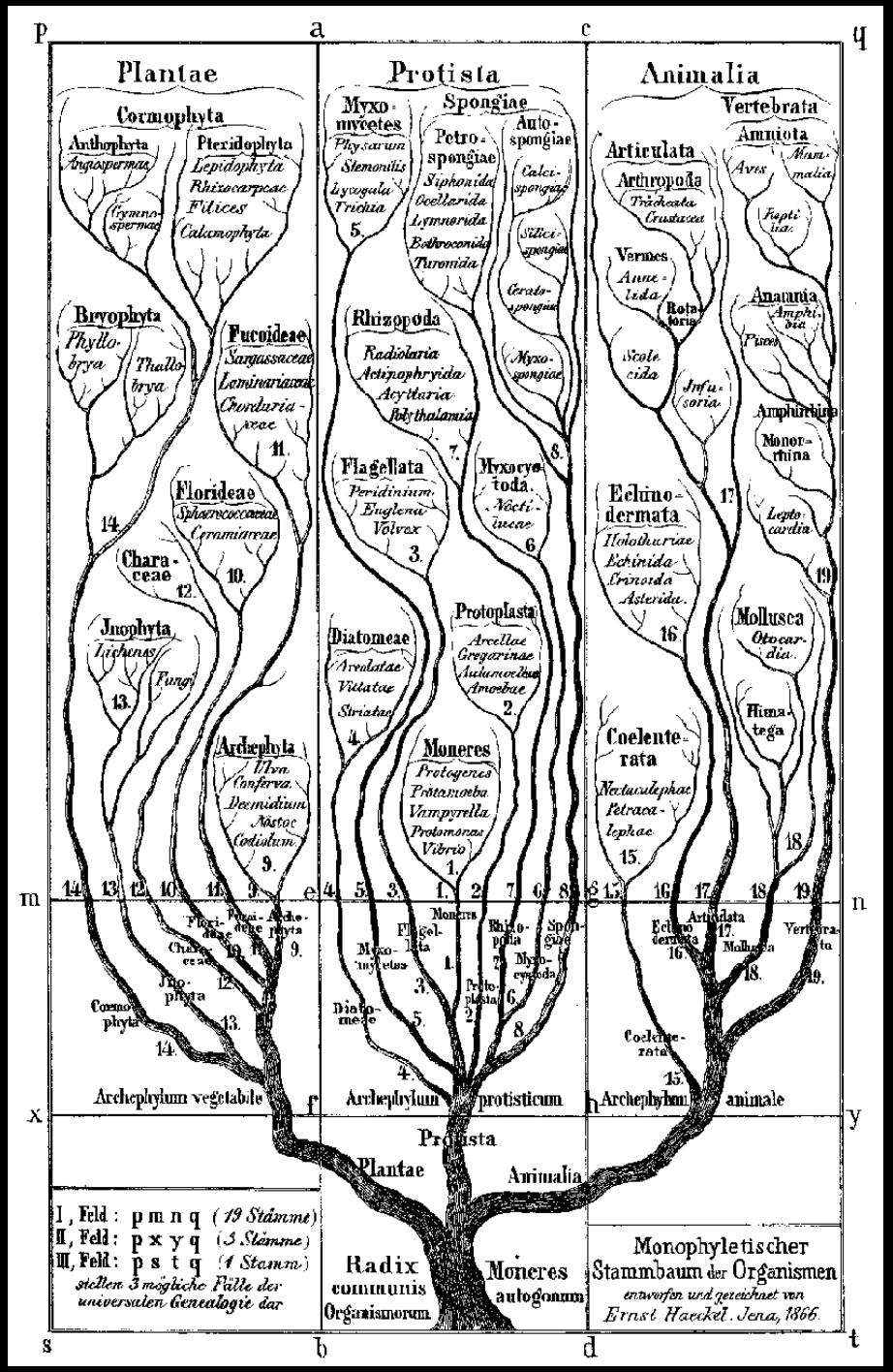
EVOLUZIONE

"La struttura ossea è la stessa nella mano dell'uomo, nell'ala del pipistrello, nella pinna del marsuino e nella gamba del cavallo; il collo della giraffa e quello dell'elefante hanno lo stesso numero di vertebre. Innumerevoli altri fatti del genere si spiegano con la teoria della discendenza attraverso lente e leggere modificazioni."

"...sono certo che la teoria della discendenza con modificazioni si estende a tutti i membri di una stessa classe. Io credo che gli animali discendano al massimo da quattro o cinque progenitori e le piante da un numero di progenitori uguale o inferiore.
L'analogia mi porterebbe ancora un passo avanti, cioè mi indurrebbe a credere che tutti gli animali e tutte le piante discendano da un unico prototipo."

Darwin, L'origine delle specie per selezione naturale (1859)



Sei turbata, mia cara, dal multiforme miscuglio
dei fiori che s'affollano in tutto il giardino;
mille nomi tu ascolti, e con barbarico accento
echeggiando all'orecchio l'uno ricaccia l'altro.
Simili tutte le forme, e nessuna identica all'altra.
Così allude il coro ad una legge occulta, a un
[sacro enigma.
Oh potessi, gentile amica, svelartelo con una sola
[parola!

(Goethe, Metamorfosi delle piante, 1798)

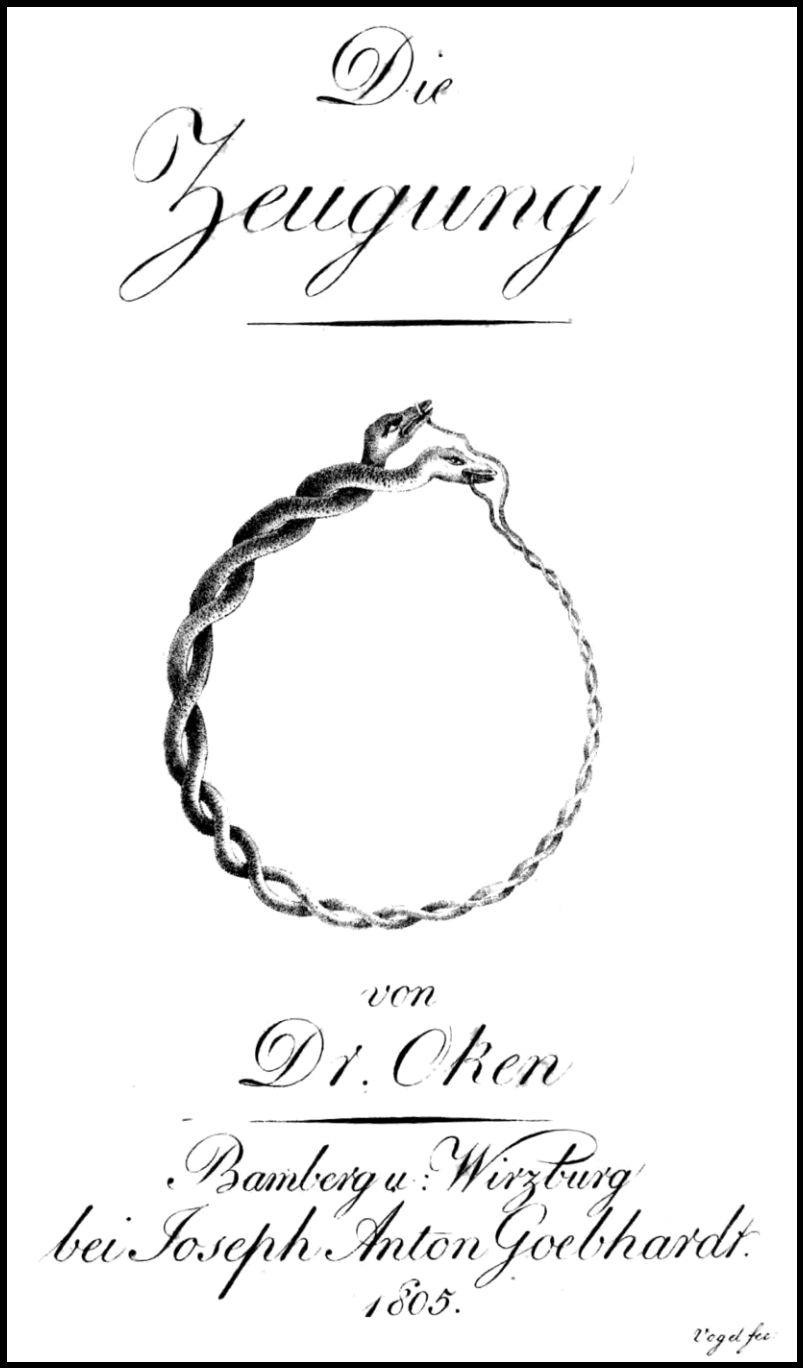
E. Haeckel, Forme artistiche della natura (1899-1904) Tavola 85: Ascidiae

La fibra è per il fisiologo ciò che la linea è per il geometra, l'elemento da cui nascono tutte le figure.

(Albrecht von Haller, *Elementa physiologiae corporis humani,* ***1757-66)***

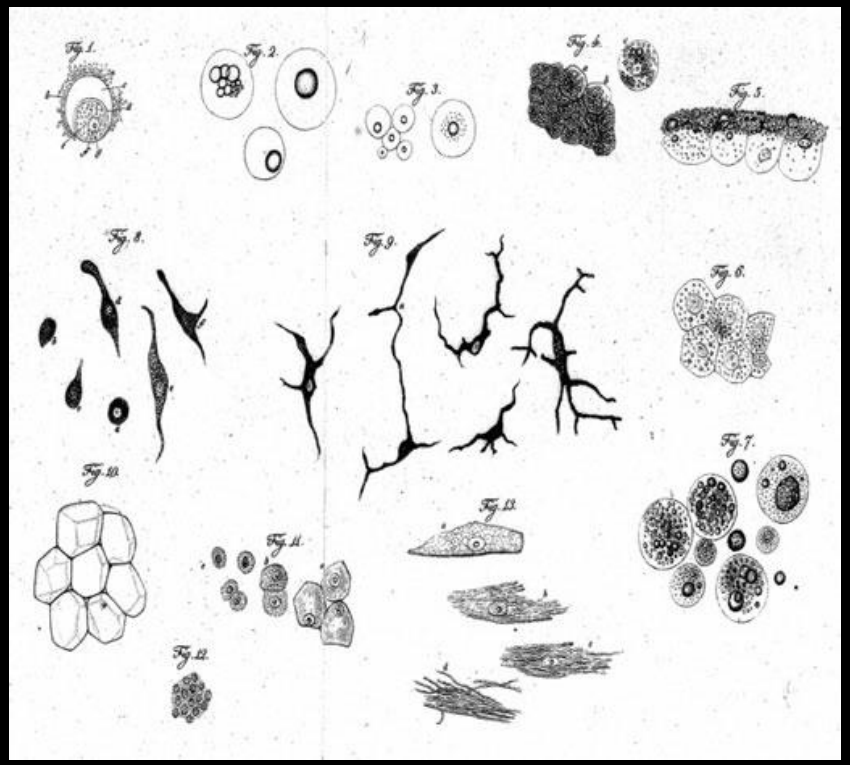
Ciò da cui originano e di cui consistono tutti gli esseri organici sono vescicole, o cellule. Tali vescicole, quando isolate e guardate nel loro originale processo di produzione, sono la massa infusoriale o protoplasma a partire dalla quale tutti gli organismi più grandi prendono forma o evolvono. La loro produzione non è quindi altro che una agglomerazione regolare di Infusori.

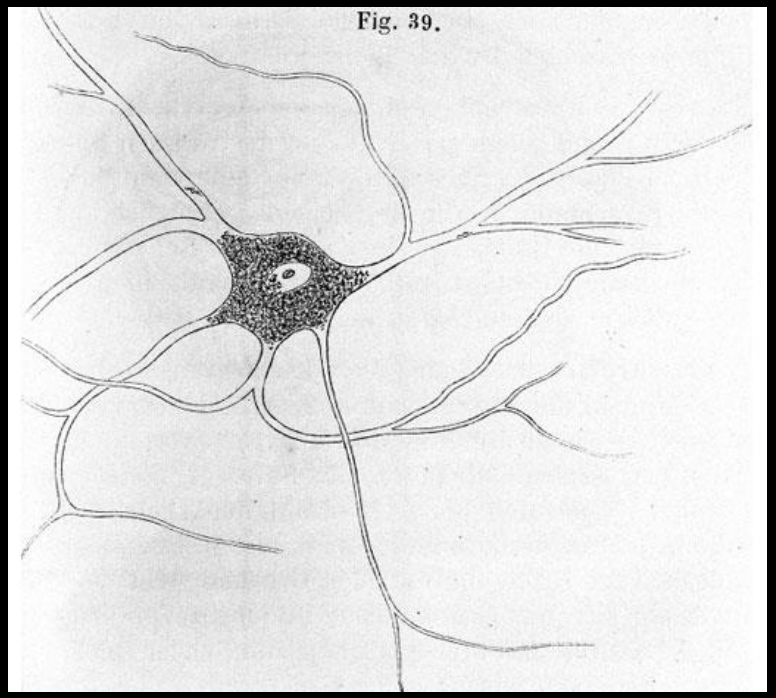
(Lorenz Oken*, Die Zeugung,* ***1805)***



Le parti elementari di tutti i tessuti sono fatte di cellule secondo modalità analoghe, benché molto diversificate, tanto che si può affermare che c'è un principio universale che regola lo sviluppo delle parti elementari degli organismi, per quanto diversi, e questo principio è la formazione delle cellule.

*(**Theodor Schwann**, Investigazioni microscopiche sulla corrispondenza nelle strutture e nella crescita di piante e animali , **1839**)*

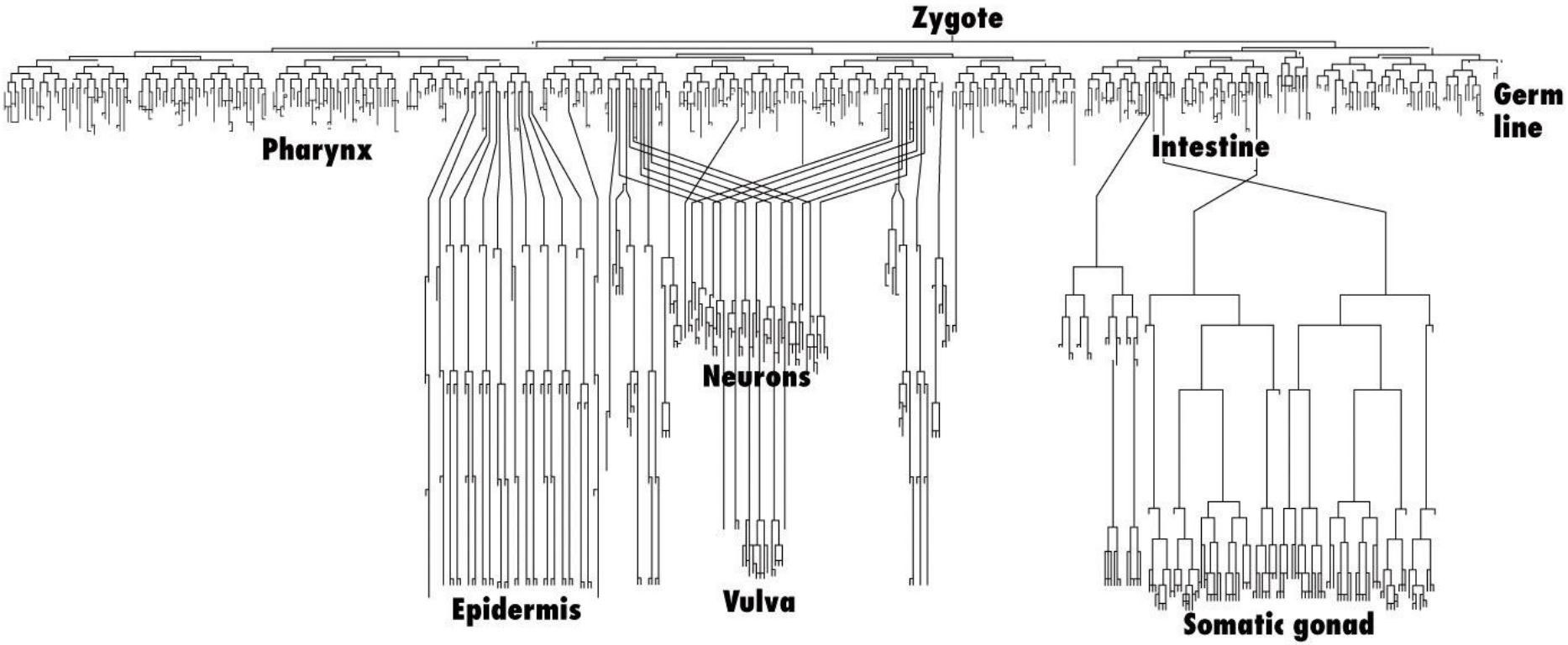




Il corretto livello di astrazione è la cellula. La cellula è l'unità fondamentale di struttura, funzione e organizzazione dei sistemi viventi –qualcosa che sappiamo da 180 anni.

*(**Sidney Brenner**, Phil Trans R Soc B, **2010**)*

Genealogia di tutte le 959 cellule somatiche di *Caenorhabditis elegans*



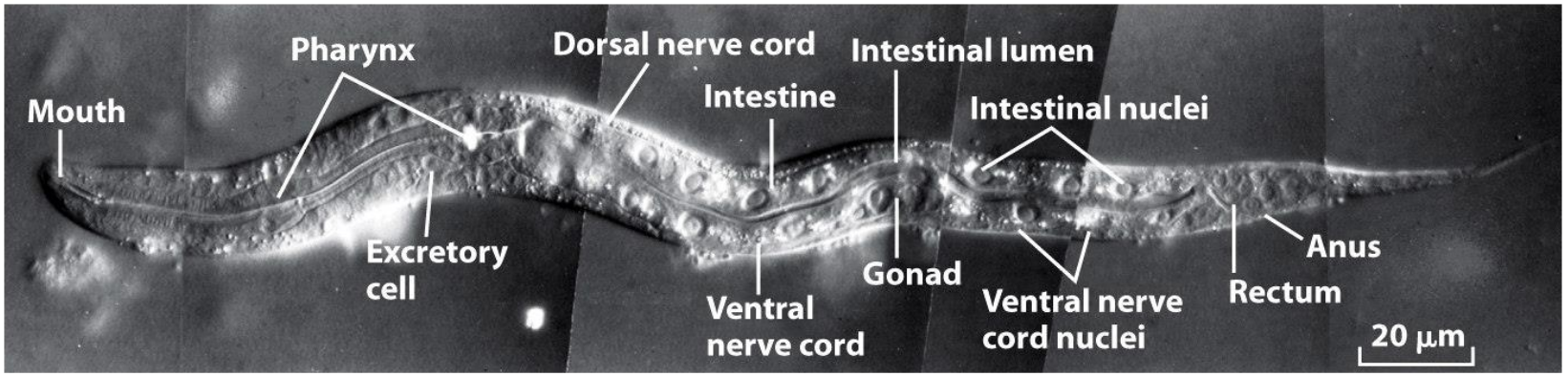


Figure 21-4
Molecular Cell Biology, Sixth Edition

Versuche über Pflanzen-Hybriden.

Von

Gregor Mendel.

(Vorgelegt m den Sitzungen vom 8. Februar und 8. März 1865.)

[F_2] The First Generation [Bred] From the Hybrids

Expt. 1. Form of seed.—From 253 hybrids 7,324 seeds were obtained in the second trial year. Among them were 5,474 round or roundish ones and 1,850 angular wrinkled ones. Therefrom the ratio 2.96 to 1 is deduced.

Expt. 2. Colour of albumen.—258 plants yielded 8,023 seeds, 6,022 yellow, and 2,001 green ; their ratio, therefore, is as 3.01 to 1.

…la parte più essenziale di una cellula vivente, la fibra dei cromosomi, può veramente dirsi un cristallo aperiodico
*(**Erwin Schrödinger**, Che cos'è la vita?, **1944**)*

STUDIES ON THE CHEMICAL NATURE OF THE SUBSTANCE INDUCING TRANSFORMATION OF PNEUMOCOCCAL TYPES

INDUCTION OF TRANSFORMATION BY A DESOXYRIBONUCLEIC ACID FRACTION ISOLATED FROM PNEUMOCOCCUS TYPE III

BY OSWALD T. AVERY, M.D., COLIN M. MACLEOD, M.D., AND MACLYN MCCARTY,* M.D.

(*From the Hospital of The Rockefeller Institute for Medical Research*)

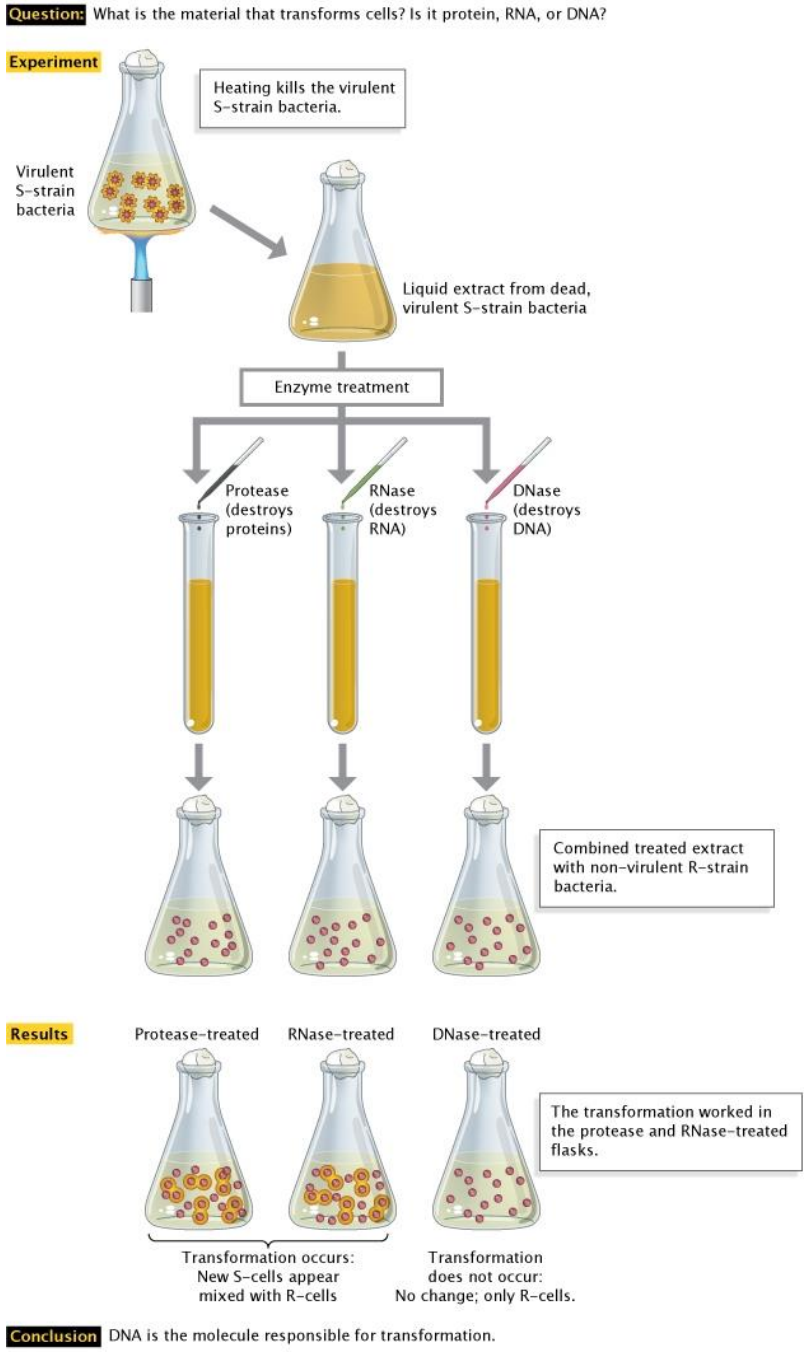
PLATE 1

(Received for publication, November 1, 1943)

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. Among microörganisms the most

CONCLUSION

The evidence presented supports the belief that a nucleic acid of the desoxyribose type is the fundamental unit of the transforming principle of Pneumococcus Type III.

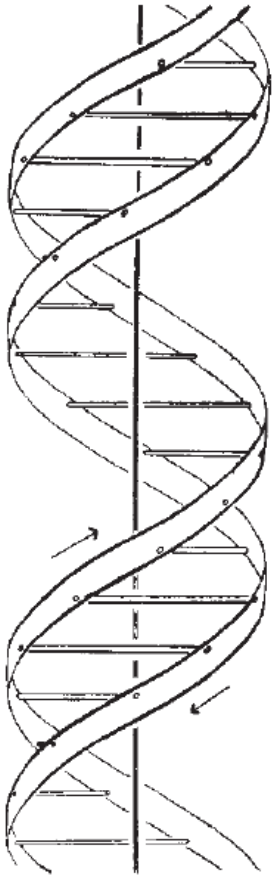


Avery et al. (1944) J. Exp. Med 79:137
Il DNA come **principio trasformante**

No. 4356 April 25, 1953 NATURE

MOLECULAR STRUCTURE OF NUCLEIC ACIDS

A Structure for Deoxyribose Nucleic Acid



It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material.

GENETICAL IMPLICATIONS OF THE STRUCTURE OF DEOXYRIBONUCLEIC ACID

By J. D. WATSON and F. H. C. CRICK

Medical Research Council Unit for the Study of the Molecular Structure of Biological Systems, Cavendish Laboratory, Cambridge

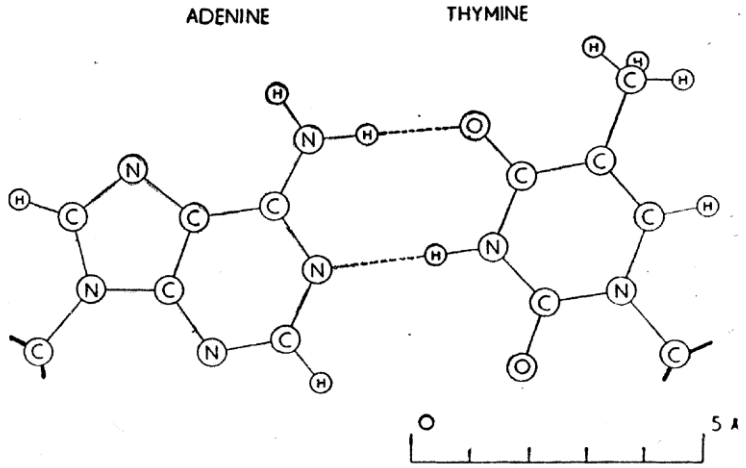


Fig. 4. Pairing of adenine and thymine. Hydrogen bonds are shown dotted. One carbon atom of each sugar is shown

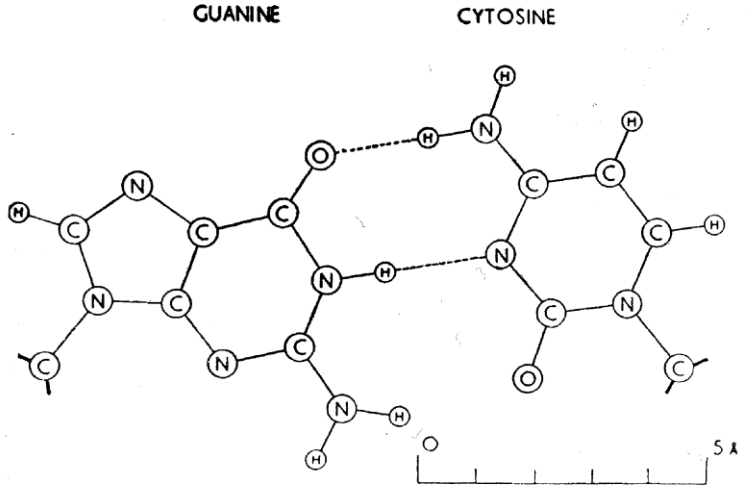


Fig. 5. Pairing of guanine and cytosine. Hydrogen bonds are shown dotted. One carbon atom of each sugar is shown

STUDIES ON POLYNUCLEOTIDES, XLIX. STIMULATION OF THE BINDING OF AMINOACYL-sRNA'S TO RIBOSOMES BY RIBOTRINUCLEOTIDES AND A SURVEY OF CODON ASSIGNMENTS FOR 20 AMINO ACIDS†*

By D. Söll, E. Ohtsuka, D. S. Jones, R. Lohrmann, H. Hayatsu, S. Nishimura, and H. G. Khorana

INSTITUTE FOR ENZYME RESEARCH OF THE UNIVERSITY OF WISCONSIN, MADISON

Communicated by Fritz Lipmann, June 23, 1965

TABLE 1

BINDING OF AMINOACYL-sRNA TO RIBOSOMES AS STIMULATED BY TRINUCLEOTIDES

Aminoacyl-sRNA (μμmoles)[a]	Trinucleotide	Background	+Trinucleotide	Other trinucleotides tested
C^{14}-Ala[c] (8.1)	GCC	0.26	0.69	CGC, CCG, GGC, CGG, UGA, GAC, GUC, UGU, GGG, CGA, CUG, UAA, UAG, CUA, AGG
	GCG	0.26	0.88	
	GCA	0.34	1.20	
	GCU	0.34	0.98	
	AGC	0.21	0.30	
C^{14}-Arg[b] (14.7)	CGA	0.75	6.50	UAG, AGU, UAA, AGC, GGG, GCC, CUA, UGU, AGG
	CGC	0.75	6.00	
	CGG	0.75	1.39	
	UGA	0.62	0.76	
	CGU	0.79	6.22	
	CCG	0.82	1.58	
	GCG	0.82	1.74	
	GGC	0.82	1.02	
C^{14}-Asn[b, e] (34.2)	AAU	0.18	0.35	UAA, ACA, CAA, UAG, CUA, UGU, GGG, AUA, AGG
	AAC	0.18	0.37	
	UGA	0.26	0.34	
C^{14}-Asp[b] (11.2)	GAU	0.16	3.86	AGU, GUA, AGC, GGG, AGG, UAA, UGU
	GAC	0.16	2.32	
	UAG	0.16	0.21	
	UGA	0.12	0.22	
	GAG	0.12	0.18	
	GGA	0.12	0.30	
	CUA	0.13	0.19	
	CAG	0.16	0.26	
H^3-Cys[b] (6.5)	UGC	0.22	1.07	GUU, UUG, UAA, UAG, CUA, AGG, GGG
	CGU	0.22	0.70	
	UGA	0.20	0.53	
	UGU	0.20	0.74	
C^{14}-Gln[c] (25.2)	CAA	0.81	3.73	AAC, ACA, UAG, UAA, UGU, AGG, GGG, CAU, CAC
	CAG	0.81	2.96	
	UGA	0.81	1.05	
	CUA	0.81	1.07	
C^{14}-Glu[b] (3.6)	GAG	0	0.44	GGG, AGG, UAA, UAG, CUA, UGU
	GAA	0.02	0.70	
	GGA	0	0.41	
	UGA	0.02	0.37	
C^{14}-Ileu[c] (Peak I) (4.1)	AUA	0.18	0.26	AAU, UAA
C^{14}-Leu[b] (22.4)	CUA	0.85	1.30	UCC, CCU, UGA, UAA, UAG, UGU, AGG, GGG, UUG, CUU, CUC, UUA
	CUG	0.85	1.48	
C^{14}-Leu[b] (Peak I) (19.3)	CUG	1.18	4.45	CUU, UUA, CUA, CUC UUG
C^{14}-Leu[b] (Peak III) (15.2)	UUG	0.61	5.10	GUU, UGU, UUA, CUU, CUA, CUC
	CUG	0.61	1.25	
C^{14}-Leu[b] (Peak IV) (6.3)	UUG	0.36	2.12	CUU, CUA, CUC
	UUA	0.36	0.51	
	CUG	0.36	0.75	
C^{14}-Lys[c] (21.2)	AAA	0.48	4.00	UAG, UGU, AGG, GGG, AUA, UGA, CUA, CAA
	AAG	0.48	3.00	
	UAA	0.48	0.66	
	AAU	0.48	0.75	
H^3-Met[c]	AUG	0.75	1.34	
H^3-Met[d] (4.1)	AUA	0.59	0.72	UGA, UAG, CUA, UGU, AGG, GGG, UAA, AAU
C^{14}-Phe[b] (11.7)	UUC	1.03	1.76	UGA, UAA, UAG, CUA, UGU, GGG
	UUU	1.03	1.56	
	AGG	0.87	1.17	
C^{14}-Pro[c] (22.7)	CCA	0.65	1.58	ACC, CAC, GCC, CGC, CUC, UCC, UGA, UAA, UAG, CUA, UGU, AGG, GGG
	CCG	0.55	1.15	
	CCU	0.50	0.77	
	CCC	0.30	0.41	
C^{14}-Ser[b] (27.5)	UCU	0.50	1.59	CUU, CCU, CUC, GUA, UGA, CGA, CUG, UAA, UAG, CUA, UGU, AGG, GGG, UUC
	UCC	0.50	1.37	
	UCA	0.50	2.06	
	UCG	0.50	2.17	
	AGU	0.50	0.62	
	AGC	0.50	0.64	

NATURE February 13, 1954 Vol. 173

Possible Relation between Deoxyribonucleic Acid and Protein Structures

In a communication in *Nature* of May 30, p. 964, J. D. Watson and F. H. C. Crick showed that the molecule of deoxyribonucleic acid, which can be considered as a chromosome fibre, consists of two parallel chains formed by only four different kinds of nucleotides. These are either (1) adenine, or (2) thymine, or (3) guanine, or (4) cytosine with sugar and phosphate molecules attached to them. Thus the hereditary properties of any given organism could be characterized by a long number written in a four-digital system. On the other hand, the enzymes (proteins), the composition of which must be completely determined by the deoxyribonucleic acid molecule, are long peptide chains formed by about twenty different kinds of amino-acids, and can be considered as long 'words' based on a 20-letter alphabet. Thus the question arises about the way in which four-digital numbers can be translated into such 'words'.

G. Gamow

George Washington University,
Washington, D.C. Oct. 22.

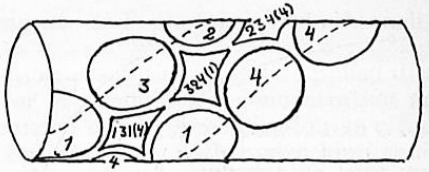
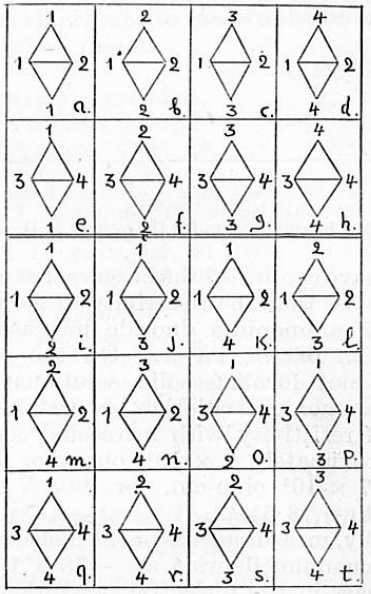


Fig. 1



Central Dogma of Molecular Biology

NATURE VOL. 227 AUGUST 8 1970

by
FRANCIS CRICK
MRC Laboratory of Molecular Biology,
Hills Road,
Cambridge CB2 2QH

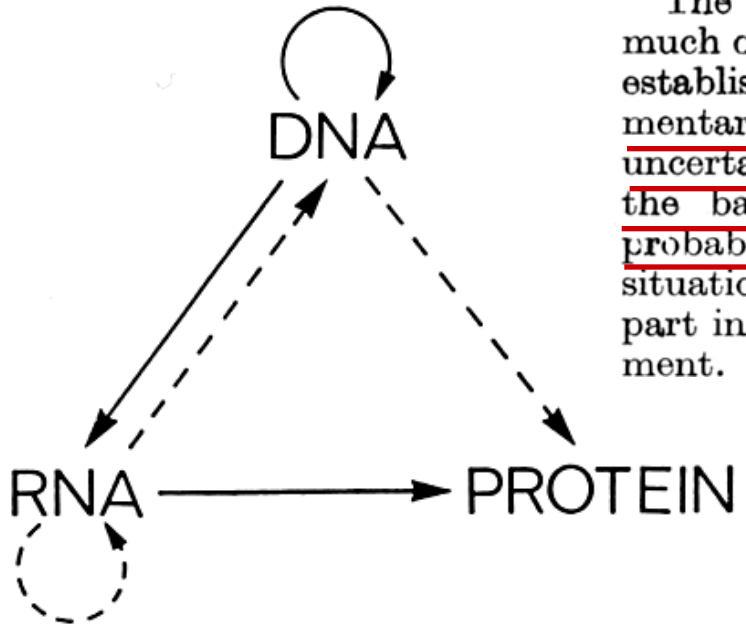


Fig. 3. A tentative classification for the present day. Solid arrows show general transfers; dotted arrows show special transfers. Again, the absent arrows are the undetected transfers specified by the central dogma.

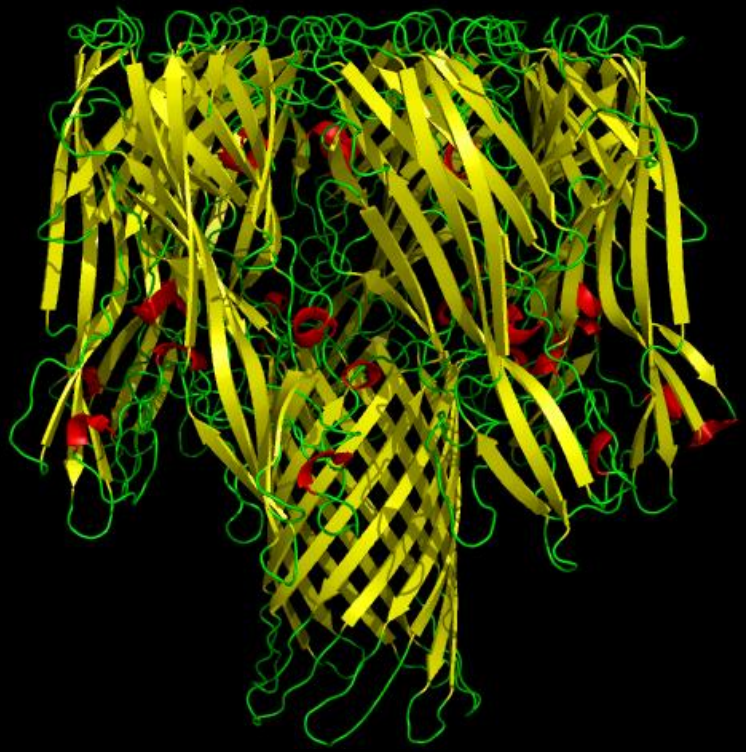
The central dogma was put forward[4] at a period when much of what we now know in molecular genetics was not established. All we had to work on were certain fragmentary experimental results, themselves often rather uncertain and confused, and a boundless optimism that the basic concepts involved were rather simple and probably much the same in all living things. In such a situation well constructed theories can play a really useful part in stating problems clearly and thus guiding experiment.

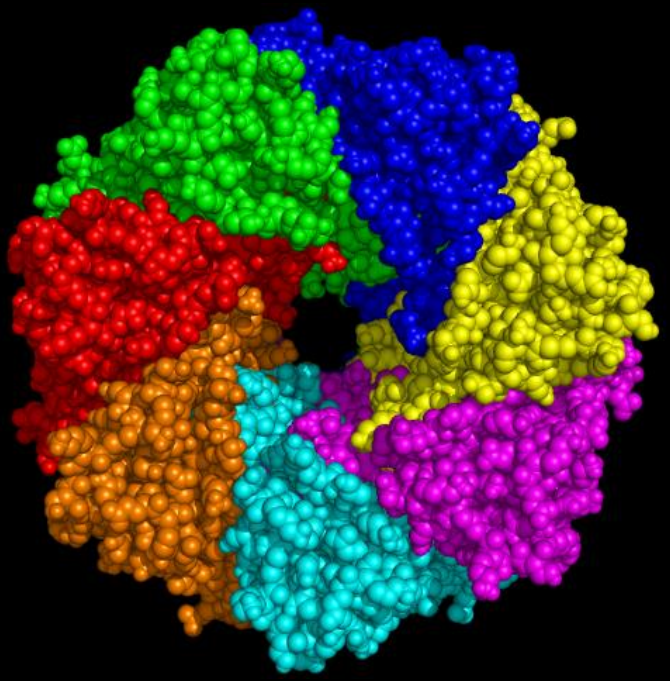
Unknown Transfers

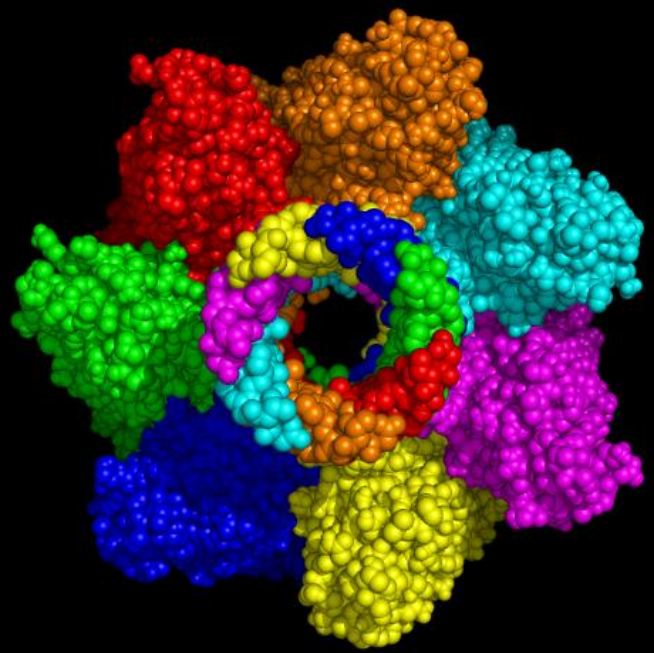
These are the three transfers which the central dogma postulates never occur:

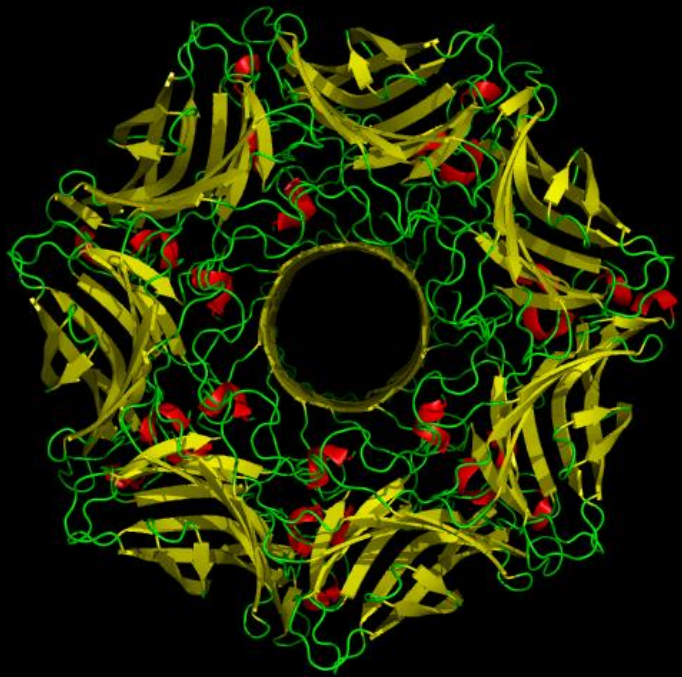
Protein→Protein
Protein→DNA
Protein→RNA

the discovery of just one type of present day cell which could carry out any of the three unknown transfers would shake the whole intellectual basis of molecular biology, and it is for this reason that the central dogma is as important today as when it was first proposed.

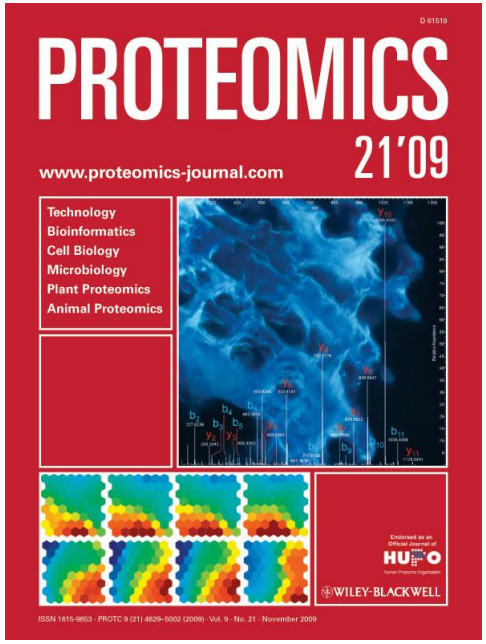









DECODING THE
BOOK OF LIFE
A Milestone
For Humanity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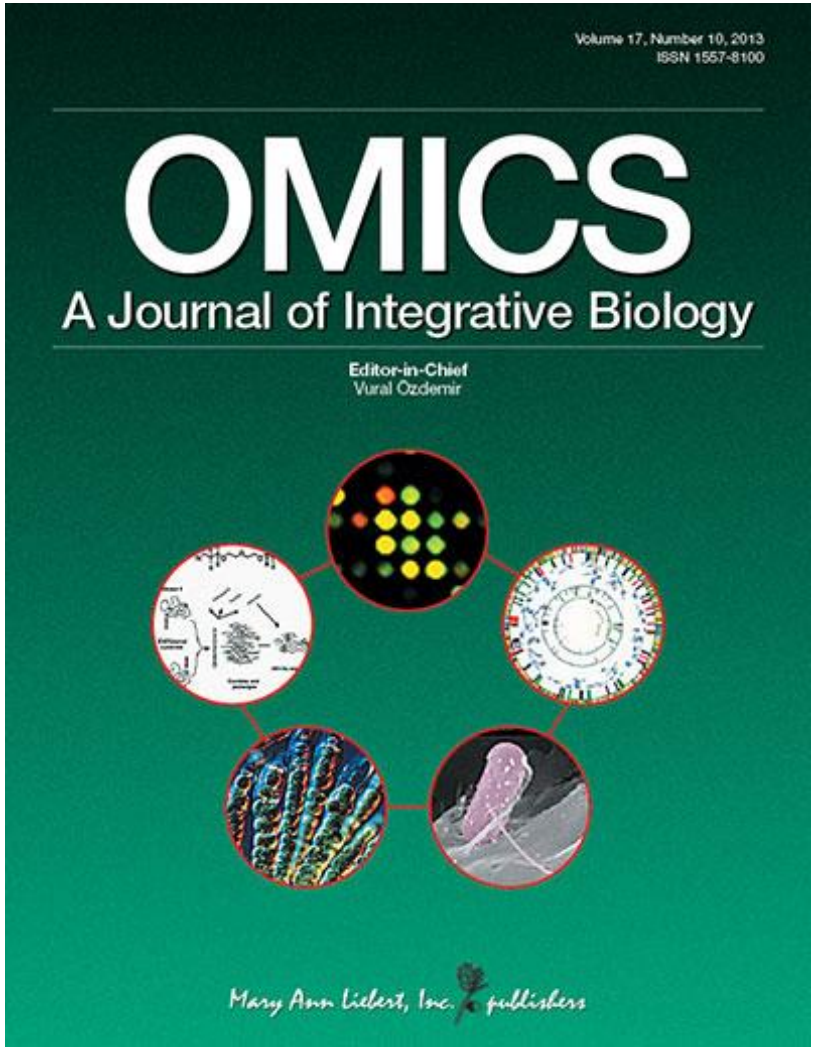
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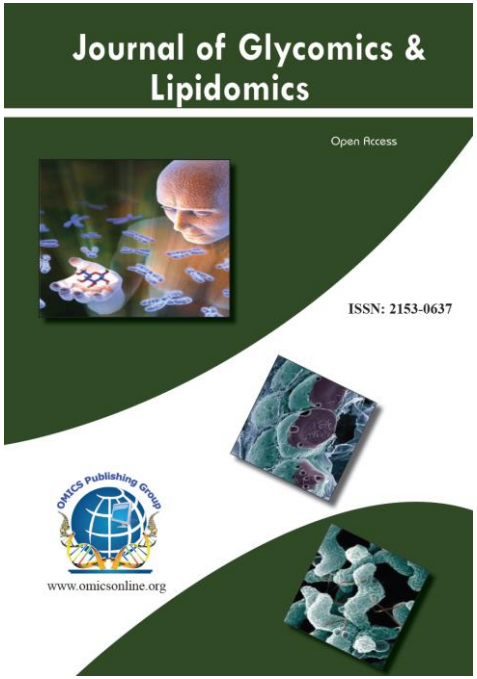
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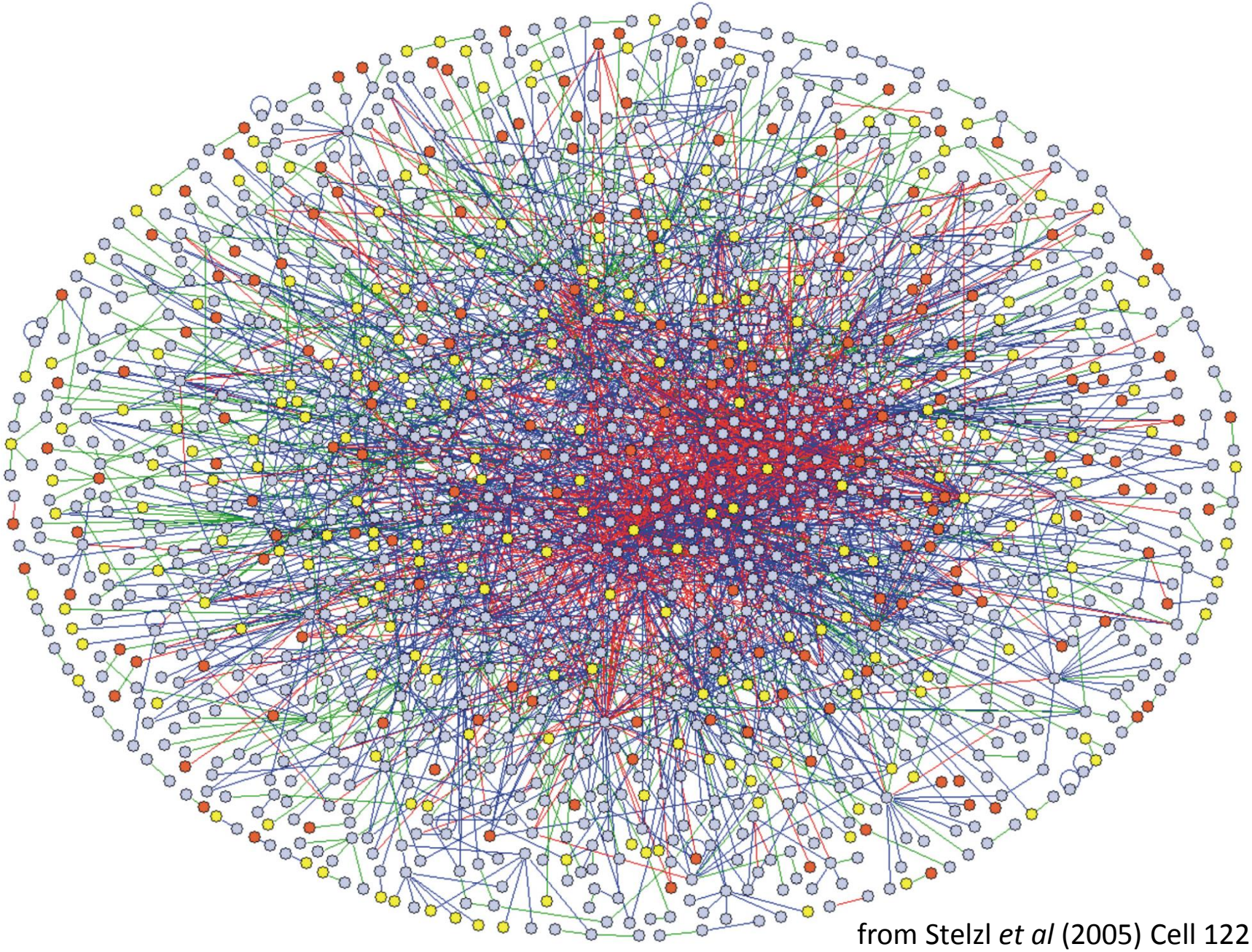
A largely incomplete (5%) network of human protein-protein interactions



from Stelzl *et al* (2005) Cell 122:957

The *Sorcerer II* Global Ocean Sampling Expedition: Expanding the Universe of Protein Families

This article is part of the Oceanic Metagenomics collection.

Shibu Yooseph[1*], Granger Sutton[1], Douglas B. Rusch[1], Aaron L. Halpern[1], Shannon J. Williamson[1], Jonathan A. Eisen[1,2], Karla B. Heidelberg[1], Gerard Manning[3], Weizhong Li[4], Lukasz Jaroszewski[4], F Christopher S. Miller[5], Huiying Li[5], Susan T. Mashiyama[6], Marcin P. Joachimiak[6], Christopher van E John-Marc Chandonia[6,7], David A. Soergel[6], Yufeng Zhai[3], Kannan Natarajan[8], Shaun Lee[8], Benjan Vineet Bafna[8], Robert Friedman[1], Steven E. Brenner[6], Adam Godzik[4], David Eisenberg[5], Jack E. Di , Susan S. Taylor[8], Robert L. Strausberg[1], Marvin Frazier[1], J. Craig Venter[1]

Table 1. The Complete Dataset Consisted of Sequences from NCBI-nr, ENS, TGI-EST, PG, and GOS, for a Total of 28,610,944 Sequences

Dataset	Source	Number of Amino Acid Sequences	Mean Sequence Length	Brief Description
NCBI-nr	NCBI	2,317,995	339	Consists of protein sequences submitted to SWISS-PROT, PDB, PIR, and PRF, and also predicted proteins from both finished and unfinished genomes in GenBank, EMBL, and DDBJ.
PG ORFs	NCBI	3,049,695	160	ORFs identified from 222 prokaryotic genome projects. Organisms are listed in Protocol S1.
TGI-EST ORFs	TIGR Gene Index	5,458,820	119	ORFs identified from 72 datasets in which each dataset consists of EST assemblies. Organisms are listed in Protocol S1.
ENS	Ensembl	361,668	466	Sequences from 12 species, including human, mouse, rat, chimp, zebrafish, fruit fly, mosquito, honey bee, dog, two species of puffer fish, chicken, and worm.
GOS ORFs	J. Craig Venter Institute	17,422,766	134	ORFs identified from an assembly of 7.7 million reads. These reads include both the reads from the *Sorcerer II* GOS Expedition and the reads from the earlier Sargasso Sea study. Also included are 36,318 ORFs identified from an assembly of sequences collected from the viral size (< 0.1 μm) fraction of one sample.

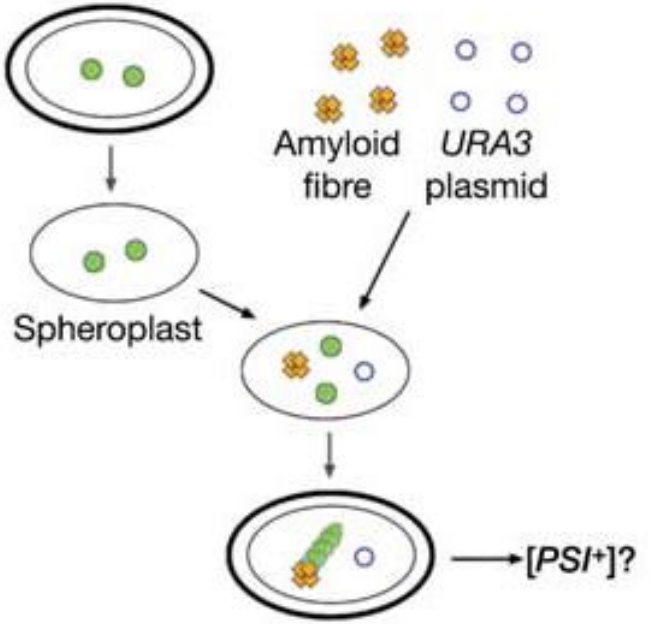
E' inutile rimpiangere gli anni d'oro della genetica molecolare, quando grandi imprese venivano compiute combinando il ragionamento con pochi e ben scelti esperimenti. Ed è pure inutile biasimare l'attuale biologia "low input, high throughput, no output" che domina le pagine delle nostre sempre più competitive riviste. Benvenuto tutto ciò che la tecnologia ci offre, ma dobbiamo imparare a usarlo in modi nuovi. La biologia ha urgente bisogno di una base teorica che la unifichi, ed è solo la teoria che ci permetterà di convertire i dati in conoscenza.

Sidney Brenner (2010). "Sequences and consequences". Phil Trans R Soc B 365:207

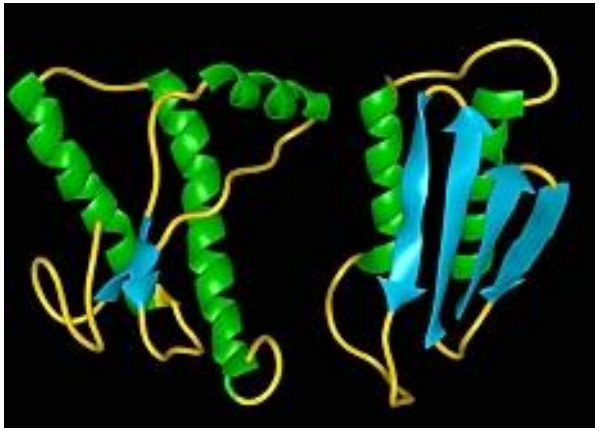
Unknown Transfers

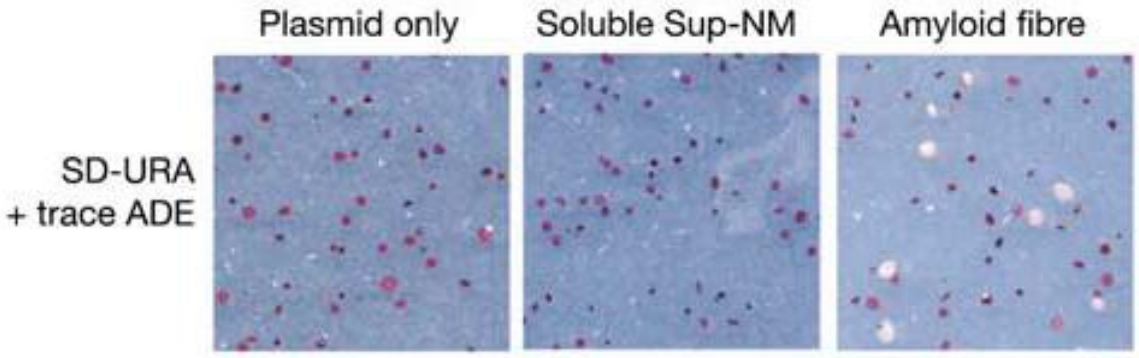
These are the three transfers which the central dogma postulates never occur:

Protein→Protein
Protein→DNA
Protein→RNA



PRIONI: proteine che agiscono come principio trasformante (agente di cambiamenti fenotipici ereditabili)



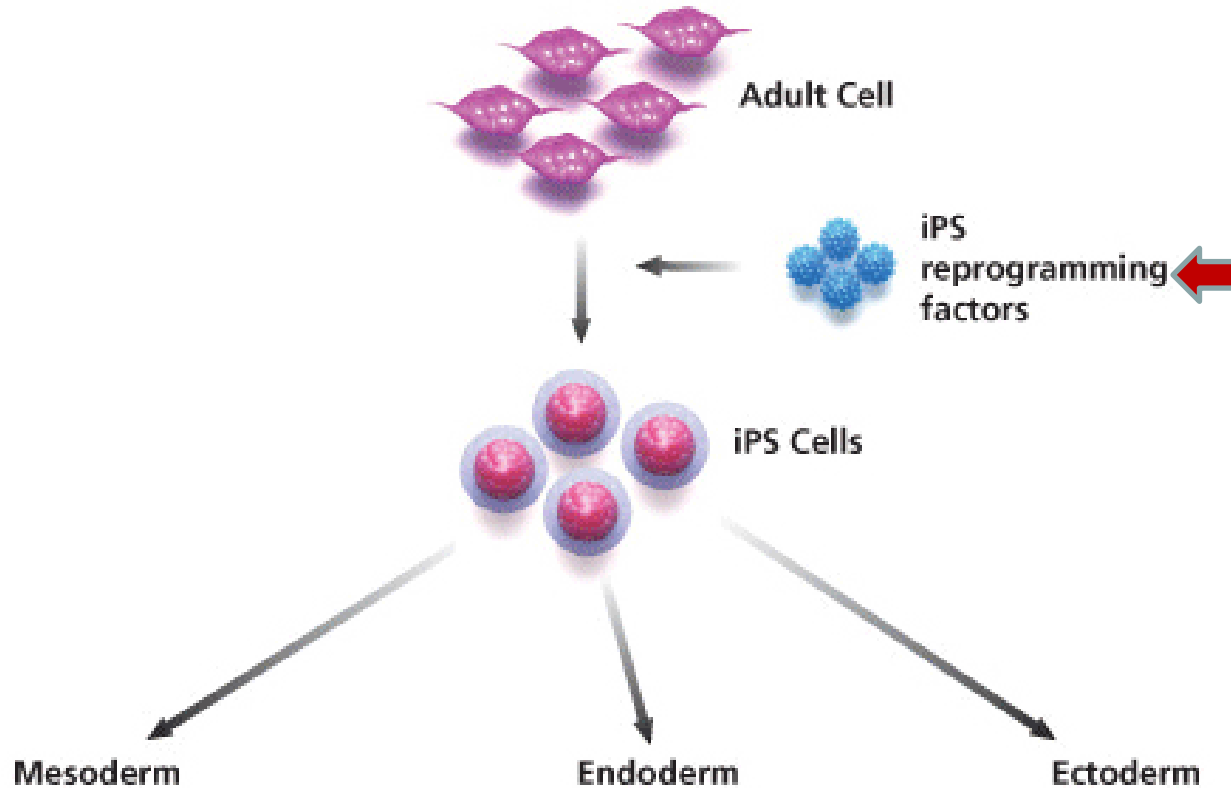


Tanaka et al (2004) Nature 428:323

Cell *131*, 861–872, November 30, 2007 ©2007 Elsevier Inc. 861

Induction of Pluripotent Stem Cells from Adult Human Fibroblasts by Defined Factors

Kazutoshi Takahashi,[1] Koji Tanabe,[1] Mari Ohnuki,[1] Megumi Narita,[1,2] Tomoko Ichisaka,[1,2] Kiichiro Tomoda,[3] and Shinya Yamanaka[1,2,3,4,*]



Fattori di trascrizione (proteici) che agiscono come principio trasformante

- E' necessario applicarsi per anni ad esercitare lo sguardo (*Goethe*)

- L'immagine del vivente costruita dalla biologia sperimentale si basa su ciò che del vivente è isolabile e manipolabile

- Non esiste ancora una vera «teoria della biologia»

«i biologi sperimentali non sono mai troppo entusiasti quando risulta che un processo era stato correttamente predetto (…) Questo è molto diverso da quanto accade nel campo della fisica, dove un'osservazione sperimentale non verrebbe in alcun modo sminuita se preceduta da una predizione teorica, al contrario. L'accoglienza di alcuni dei miei modelli ha avuto una strana storia. Prima venivano considerati non realistici o erronei: 'non può essere'. Più o meno all'improvviso questo diventava poi: 'è banale, come altro dovrebbe essere?'. (…). Entrambi gli atteggiamenti danno la libertà di ignorare il lavoro teorico»

(*Hans Meinhardt*)

- **Il pensatore non dogmatico non reprimerà la testimonianza della vita**

(*H. Jonas*)