Abstract of presentation at the Phi Beta Kappa address,
American Association for Advancement of Science,
February 28, 1974.

Title: " Do Scientists Understand Science?"

As Medawar and many others have pointed out, scientific papers sacrifice personal truth for the sake of clear exposition of varifiable public assertions of scientific fact. To that extent intellectual historians must beware of relying on such documents as they already know how to be skeptical of autobiographical retionalizations.

To the extent that the scientific process is not revealed in scientific publications, it may be credibly inferred that scientists do not understand science or at least that their perspective on the subject is limited to but a little more than their own personal and often subjective experience.

The talk was in large measure an appeal to scientists to be more actively interested in collaboration with historians and sociologists in order to achieve a better understanding of the larger frame of their work. There are however serious methodological limitations in the study of intellectual history, especially at the micro-level of specific case studies. Inevitably we will find poor records; unreliable witness and report; an inherent discontinuity of creative thinking at the micro-level; a retrospective urge to make the story interesting as well as acurate.

The major theme of the presentation was the pre-history of molecular genetics, especially in the interval between 1875 and 1945. This was an enlargement of a brief note (attached) and leans heavily on the ongoing collaborative study with Zuckerman, Merton, Thackrey and Elkana that has been mentioned elsewhere.

The finding in 1946 in which the author participated that bacteria were endowed with mechanisms for sexual reproduction, played a significant role in the further development of microbial and molecular genetics. However, the question may be asked why did the myth prevail for so long that bacteria are asexual!

The origin of this myth was traced to the observations by von Leuwenhoek in 1675 who had observed protozoa copulating and remarked on their sexual behavior but notably failed to find comparable evidence for sex in his microscopic observations on bacteria. While there are many other subtleties that would need to be considered, this could be put down to the gross incapability of the microscope to go quite that far in the analysis of cellular processes. In 1875 Ferdinand Cohn systematized the biology of bacteria for the first time and was obliged to react strongly to a number of other myths about these organisms - for example, as an extrapolation of the shattered myth of spontaneous generation that there was but one species of bacterium which was capable of spontaneous evolution into the full variety of microbial forms as a matter of everyday contemporary experience. His conservative reaction postulated the strict genetic stability of bacteria (the doctrine of monomorphism) and rigidified the concept of bacterial asexuality even in the class name schizomycetes. Subsequently, the rapid separation of the disciplines of microbiology, as an applied medical subject of overwhelming human significance, from the main stream of basic academic biology, impeded a fundamental re-examination of these premises of microbiological science.

The renewal of evolutionary analysis in the 1940's, the general ferment to the greater social investment in scientific and especially in biological research during and immediately after WW II and a variety of other social, historical, intellectual and personal factors were reviewed as helping to explain the eventual re-examination and overturning of

the myth of asexuality.

Behind the picture of premature and postmature discovery which is recounted here is an implied model of the nature of scientific progress which has been sketched out only in rather crude terms and requires much deeper examination.

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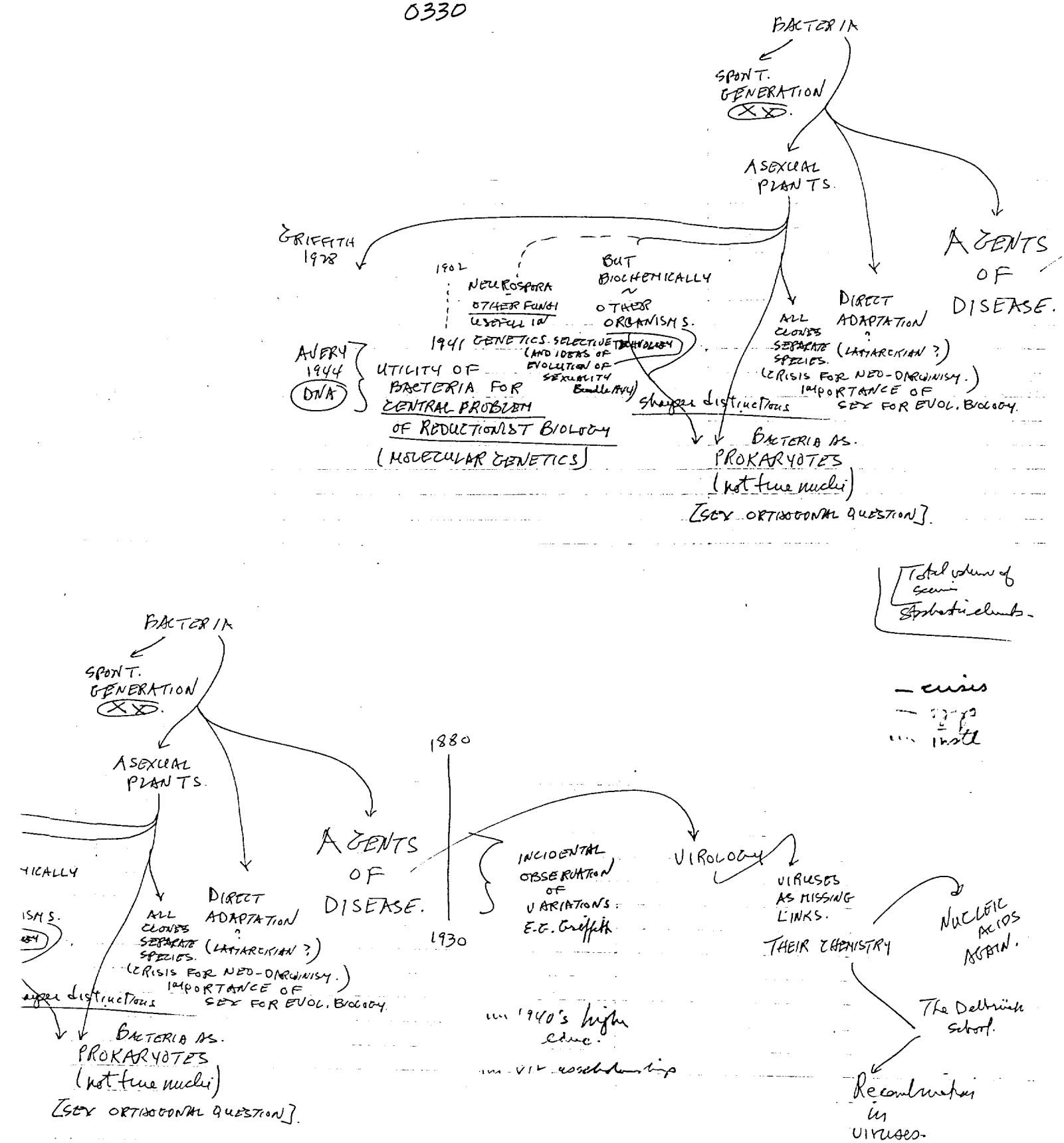
BACTERIA
SPONT. GENERATION
ASEXUAL PLANTS
GRIFFITH 1928
1902
NEUROSPORA
OTHER FUNGI
USEFUL IN
1941 GENETICS. SELECTIVE
(AND IDEAS OF EVOLUTION OF SEXUALITY
BUT BIOCHEMICALLY
OTHER ORGANISMS.
AVERY 1944
DNA
UTILITY OF BACTERIA FOR CENTRAL PROBLEM OF REDUCTIONIST BIOLOGY
(MOLECULAR GENETICS)
DIRECT ADAPTATION
ALL CLONES SEPARATE SPECIES.
(LAMARCKIAN ?)
(CRISIS FOR NEO-DARWINISM.)
IMPORTANCE OF SEX FOR EVOL. BIOLOGY.
AGENTS OF DISEASE.
BACTERIA AS PROKARYOTES
(not true nuclei)
[SEX ORTHOGONAL QUESTION]

BACTERIA
SPONT. GENERATION
ASEXUAL PLANTS
1880
1930
AGENTS OF DISEASE.
INCIDENTAL OBSERVATION OF VARIATIONS: E.G. Griffith
VIROLOGY
VIRUSES AS MISSING LINKS.
THEIR CHEMISTRY
NUCLEIC ACIDS AGAIN.
The Delbrück school.
Recombination in viruses.
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IMPORTANCE OF SEX FOR EVOL. BIOLOGY
BACTERIA AS PROKARYOTES
(not true nuclei)
[SEX ORTHOGONAL QUESTION]
1940's high educ.
VIR research
Total volume of semi Sphaeriales
crisis
Insect

1940's. Adaptation
Lysenko-Lamarck
Fungal Genetics
Unity of Biochemistry
Sexual Reproduction in Evolutionary Theory
Cytological and Biochemical Complexity of Bacteria
Mutation analogies

Avery → utility of bacteria for central problem of reductionist biology

TODAY — O.T.S.O.G. AT 4% ? → AREORE

6/70 — DNA SEQUENCES SYNTHESIZED

1/67 — PHAGE DNA REPLICATED.

2/63

DNA POLYMERASE

1952 — DOUBLE HELIX
PHAGE TRANSDUCTION

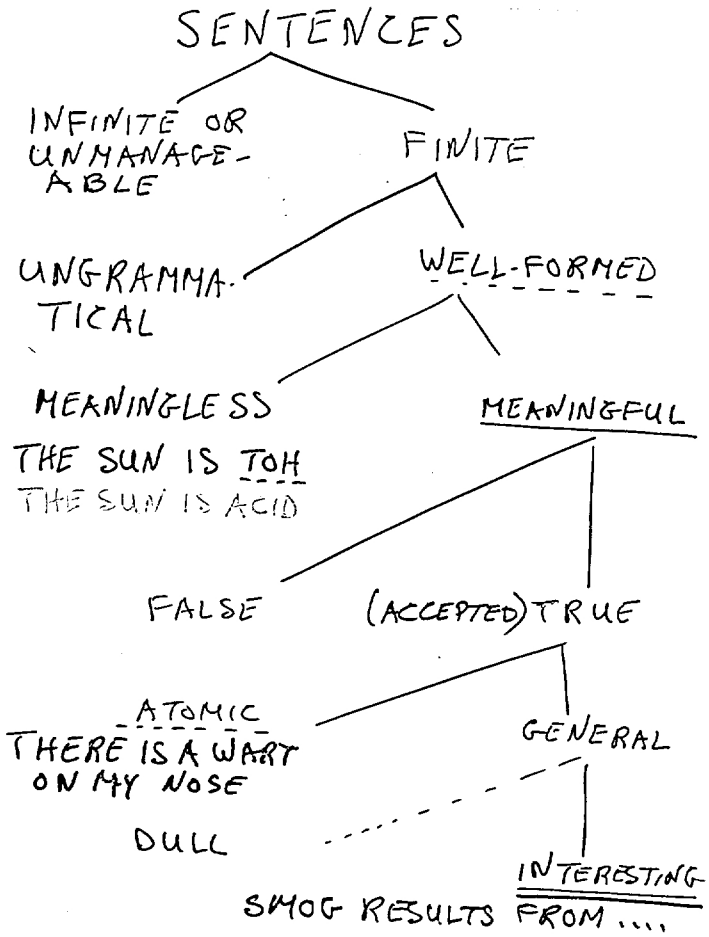
1944 — SEX IN BACT. AVERY
NEUROSPORA

1928 — DROSOPHILA GRIFFITH

1900 — MENDEL ↕ PASTEUR COHN

1800 — DARWIN

JL



1675 Leeuwenhoek sees Bacteria

1692 Protozoa (copulating!)

1860 Pasteur still debating S.G.

1830s - 1870 Foundations of Modern Bacteriology.

Cohn: 1875 SCHIZOMYCETES

1893 San Felice

1920's Lohnis; Mellon Almquist

1928 GRIFFITH

1944 AVERY

1946 Bacteria sexual after all.