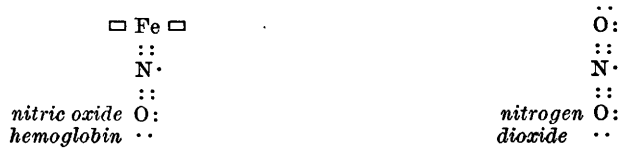
and nitric oxide hemoglobin with nitrogen dioxide:



It is interesting that molecular oxygen, carbon monoxide and nitric oxide each combine with nascent oxygen, under appropriate conditions, to form the homologues listed. Nascent oxygen could therefore be considered a homologue of reduced hemoglobin:

Inasmuch as ozone, carbon dioxide and nitrogen dioxide are hydrated to form acids, it is suggested that the increased acidity of hemoglobin, attendant on its oxygenation or carbonylation, is due to hydration of the resulting compound with the formation of one or 2 additional acidic groups.

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Active Immunization in Human Cases with the Polysaccharide of Pneumococcus Type I.

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Tillett and Francis[1, 2] showed that patients suffering with pneumonia who were injected intracutaneously with small amounts of pneumococcus polysaccharide of the homologous and heterologous types, showed after some time antibodies not only against the infecting type of organism but against the other types. In explanation they suggested that probably the injections of the heterologous polysaccharides produced antibodies.

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[1] Tillett, W. S., and Francis, T., *J. Exp. Med.*, 1929, **50**, 687.

[2] Francis, T., and Tillett, W. S., *J. Exp. Med.*, 1930, **52**, 573.

Finland and Sutliff[3] confirmed these findings and in addition[4] showed in humans with histories free of recent infection antibody production following the intracutaneous injection of protein-free type specific polysaccharides of either Type I, II, or III Pneumococci.

The present study deals with antibody response following intracutaneous injection of a type specific polysaccharide of Pneumococcus Type I prepared according to the method of Heidelberger, Sia and Kendall.[5] Using the same dose as that used by Tillett and Francis[1] in their work on cutaneous reaction to pneumococcus polysaccharides during lobar pneumonia, 0.1 cc. of a 1:10,000 dilution or 0.01 mg., 10 normal human subjects without recent infection were given 5 weekly intradermal injections of Pneumococcus Type I polysaccharide SSS Pn. I F. The cutaneous reactions varied greatly in intensity in different individuals, positive reactions being elicited in a percentage of these subjects contrary to the findings of the aforementioned workers, who observed positive reaction with very few exceptions only in pneumonia patients at time of crisis and after. Maximum reaction consisted of a bright rash-like erythema 40x50 mm. with pseudopods and itching, appearing within 5 to 15 minutes of injection and followed by marked swelling and tenderness and a central area of redness, reaching its height within 2 hours and gradually diminishing. Intermediate reactions were those of varying degree of erythema and wheal formation and finally clear-cut negative results were observed. There was no apparent relation between these cutaneous reactions and the degree of natural or induced immunity. An irregular variation was also observed in some individuals in the cutaneous reactions following the different injections of the series.

Bleedings were taken prior to injection and one week after the final injection and the serum tested for protective antibodies, precipitins and agglutinins. Subsequent bleeding at monthly intervals were taken from a portion of the group to determine the duration of any acquired immunity.

Homologous antibody response was demonstrated in all cases following the intradermal injections, the serum showing protection against virulent Pneumococcus Type I culture in amounts from 10 M.F.D. to 100,000 M.F.D. This immunity was still demon-

[3] Finland, M., and Sutliff, W. D., *J. Exp. Med.*, 1931, **54**, 637.

[4] Finland, M., and Sutliff, W. D., *J. Exp. Med.*, 1932, **55**, 853.

[5] Heidelberger, M., Sia, R., and Kendall, E. E., *J. Exp. Med.*, 1930, **52**, 477.

strable with little or no decrease 3 months after the final immunizing injection.

No agglutinins were demonstrable in any of the sera. Precipitin reactions with the homologous polysaccharide were obtained, the dilution of the serum giving a reaction corresponding however only roughly to the passive protection titre. No precipitins were found in any of the normal sera showing no natural immunity but were demonstrable in the one case in which natural passive protection was noted.

A summary of the results is given in Table I.

TABLE I.
Immunization of Humans with Pneumococcus Type I Polysaccharide Skin Reaction and Passive Protection.

Subject	Normal Bleeding		Skin Reaction to Weekly Intradermal Injections				Interval Between Last Immunizing Injection and Bleeding									
							1 Week		5 Weeks		9 Weeks		3 Mo.			
	Precipitin Titre	Passive Protection for Mice					Passive Protection M.F.D.	Precipitin Titre	Passive Protection M.F.D.	Precipitin Titre	Passive Protection M.F.D.	Precipitin Titre	Passive Protection M.F.D.	Precipitin Titre	Passive Protection M.F.D.	Precipitin Titre
JC	Neg.	Neg.	4	3	3	3	1000	Neg.	1000	1:6	1000	1:2	1000	1:2	1000	
FE	,,	,,	0	0	0	0	1000	,,	1000	1:2	1000					
EB	1:2	1000 M.F.D	2	2	1	2	2	,,	10000							
LM	Neg.	Neg.	3	3	3	3	3	1:6	10000	1:2	100000	1:10	1000	1:2	10000	
EE	,,	,,	1	±	±	±	0	Neg.	50	Neg.	100	Neg.	10	Neg.	100	
AC	,,	,,	2	3	3	1	1	,,	10							
IG	,,	,,	0	0	0	0	0	,,	1000							
RF	,,	,,	1	±	0	0	0	,,	1000					Neg.	100	
RH	,,	,,	0	0	0	0	0	1:2	500							
MP	,,	,,	1	1	±	2	1	1:2	1000							

Precipitin Titre—Serum dilution giving precipitin reaction with SSS Pn I F 1:10000. Read after 4 hours at 37°C. 5° overnight and centrifuged.

Passive Protection for Mice—Number of minimum fatal doses of a 7-hour culture of Pneumococcus Type I against which 0.2 cc. of serum protects mice.

Skin reaction to 0.1 cc. of 1:10000 of SSS Pn I F:

4—Maximum Reaction—Erythema and swelling 40x40 mm.
3—Marked Reaction—Erythema and moderate swelling 30x30 mm.
2—Moderate Reaction—Erythema 20x25 mm.
1—Slight Reaction—Erythema 10x15 mm.
±—Very slight reaction—Slight erythema 5x10 mm.
0—No reaction.