investigator may introduce suitable meters, etc., at appropriate places in the output or stimulating circuit. As a result of further work, we recommend a larger generator than that described above, yielding stronger currents at low frequencies. For the subsequent development of this field of investigation such a generator has been designed and installed in this laboratory, and will be described later; using it, satisfactory masking occurs with currents of about 100 to 300 cycles per second, 5 to 10 volts and 0.5 to 3 milliamperes. All our work on nerve areas, however, was done with the small alternator. Possibly currents generated otherwise may yield similar results.

The space available here precludes reference to the difficulties inherent in such a procedure; these will be discussed in a more detailed publication. The method is not easy, and demands practice and patience on the part of observer and subject alike. We have encountered one or two subjects who, for some obscure reason, possibly physiological or psychological, were unsatisfactory for such work, wherein the importance of reliable subjective responses is obvious. Outlining the same area on the same subject on different occasions has yielded reasonably consistent results.

The nature of the results is indicated in Fig. 2.

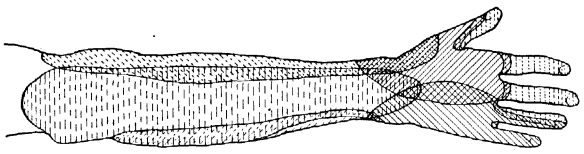

FIG. 2. A sketch of the dorsal aspect of the right forearm and hand of an adult male, showing the cutaneous areas supplied by various nerves; these are not labelled, for anatomists will recognize them. In this individual the median nerve supplied the entire dorsal aspect of the index and middle fingers. The extent of the overlaps is easily seen. In this person certain small areas on the back of the wrist were supplied by three cutaneous nerves: for example, that in the middle is seen to be supplied by the dorsal cutaneous nerve of the forearm, the radial and the ulnar.

So far as we know, ours are the first pictures of the *complete* innervation, *including overlap areas,* of any region of the body in single individuals. We have succeeded in estimating the size of these areas and in studying their variations; preliminary results have been presented by Thompson, Inman and Brownfield, and by Thompson[1]; a detailed analysis is being prepared.

I. MACLAREN THOMPSON
VERNE T. INMAN
UNIVERSITY OF CALIFORNIA
MEDICAL SCHOOL
DIVISION OF ANATOMY
BERKELEY, CALIFORNIA

CELLOPHANE ROLL FILMS AND THE FIXING OF CARBON PAPER TYPING ON CELLOPHANE[1]

THE wide-spread interest in the use of cellophane for slide lanterns[2] seems to justify reference to the paper presented by the authors[3] before the Division of Chemical Education of the American Chemical Society, at Denver, Colorado, on August 24, 1932.

A cellophane roll film carrier was described for using the cellophane in rolls instead of slides. The device is fitted into any ordinary slide lantern with no modification of the lantern necessary. Any one interested in this device will find a scale drawing for one form of it given in the *Journal of Chemical Education.*[3] The cellophane roll film carrier will hold over 33 feet of 0.001 inch thick cellophane. This is equivalent to about 120 slides, yet forms a roll less than ¾ inch in diameter, and weighs less than one glass slide. The article also gives a description of methods of preparing the films, including colored pen work; also uses of such films, and methods of fixing carbon paper typing.

Typing on cellophane slides and films is done with carbon paper. Every one seems to have had trouble with smearing of such typing, but we have worked out a simple method which is so satisfactory that a roll film has been used over 400 times and still shows no evidence of smearing. A brief description of it may be of interest to readers of SCIENCE.

The procedure consists of passing the typed film through a suitable liquid and carefully blotting it between unglazed paper while it is still moist, care being taken that the blotting paper does not slide over the wet surface. The paper removes most of the liquid and the excess ink. The film is then placed between dry paper and pressed for several minutes to complete the fixing.

Of fifty chemicals tried, organic liquids for the most part, the most satisfactory for the purpose are: amyl acetate, ethyl acetate, methyl acetate, acetaldehyde, benzyl alcohol, iso-amyl alcohol, ethylene glycol monoethyl ether ("cellosolve") and a mixture of 75 per cent. di-ethyl ether and 25 per cent. ethyl alcohol.

Other liquids fairly satisfactory are: iso-butyl alcohol, iso-propyl alcohol, methyl-ethyl ketone, acetone, ethylene chloride, ethylene bromide, benzyl

[1] Contribution No. 89 of the Division of Industrial Sciences of West Virginia University.

[2] "Lantern Slides from Cellophane," John L. Wilson, *Jour. Chem. Educ.*, 8: 2212 (November, 1931); "A New Use for Cellophane," K. L. Warren, SCIENCE, 76: 573, (December 16, 1932); "Cellophane for Slide Lanterns," B. H. Walden, SCIENCE, 77: 91 (January 20, 1933); "The Radio-Mat," F. L. Wells, *ibid.*

[3] "Cellophane Roll Films for Slide Lanterns" was sent to the *Journal of Chemical Education* on July 20, 1932, and appears in a somewhat abbreviated form in *Jour. Chem. Educ.*, 10: 92–94 (February, 1933). Since August numerous brief references to the paper have appeared in the daily press and periodicals.

chloride, nitrobenzene, di-ethyl aniline, pyridine, and carbon tetrachloride.

Results are much better when the chemicals of the first list are used.

ROSS BONAR
FLOYD BONAR
EARL C. H. DAVIES

CHEMISTRY DEPARTMENT
WEST VIRGINIA UNIVERSITY
MORGANTOWN, W. VA.

SILK CELLOPHANE FOR LANTERN SLIDES

RECENTLY Warren,[1] Walden,[2] and Wells[3] suggested the use of plain cellophane as a recipient of carbon in projection lantern slides. As a further suggestion, special du Pont Number 300 white silk cellophane takes ink directly from the typewriter ribbon without smudging and, after momentary drying, the record is permanent. If the original impressions are gone over for the second typing, legibility is enhanced. The cost of this special silk cellophane is less than one cent per slide.

FREDRICK F. YONKMAN

SCHOOL OF MEDICINE
BOSTON UNIVERSITY

SPECIAL ARTICLES

THE RELATIONSHIP OF BACTERIUM GRANULOSIS TO TRACHOMA

THE question of the relationship of *Bacterium granulosis* to the etiology of trachoma has been discussed in a recent publication.[1] As stated in that article the organism of Noguchi "merits consideration as the etiological factor" in the disease. This view was expressed in spite of the accumulation of negative evidence of many workers, including the writer, and the doubts which have been expressed by some who have been the most sanguine in their expectation of the solution of the trachoma problem following the isolation of this organism with which a transmissible granular condition may be produced in monkeys. Such doubts are based on the failure of many investigators to isolate the organism from trachoma in different parts of the world and the considerable number of negative results which have been obtained in attempting to produce trachoma by inoculation of human subjects with the organism.

I reported that the granular condition originally induced with difficulty in *Macacus rhesus* monkeys by inoculation with cultures of *Bact. granulosis* was very readily transmissible and that transmission could be accomplished by merely rubbing a sterile swab over the affected conjunctiva and then rubbing it over the conjunctiva of a normal animal, thus demonstrating the fact that it is not necessary to excise tissue and to inject this subconjunctivally. In other words, as described by one worker, the granular condition may be described as one which is "highly infectious."

The question arose: "Is human trachoma as readily transmissible?" There are a number of clinicians who, after long experience with trachoma, still question the ready communicability of the disease. On the other hand, Taborisky[2] inoculated the conjunctiva of 5 blind subjects with the conjunctival secretion of trachoma cases and all acquired the disease.

In order to obtain a comparison between the granular condition induced in monkeys by inoculation with cultures of *Bact. granulosis* and that induced by direct transfer of secretions from trachoma cases, a series of monkeys was started in the early part of 1932 in which granular lesions were produced by repeated swabbing of secretions from trachoma cases in Rolla, Missouri. A number of attempts had previously been made to accomplish this without success. A granular condition which developed slowly was obtained in 2 monkeys and from one of these was transmitted to another monkey by repeated swabbing. As reported recently[3] two parallel series of monkeys (8 in each series) were then considered, one in which attempts were made to transmit the granular condition originally induced by inoculation with cultures of *Bact. granulosis* and the other in which attempts were made to transmit the granular condition originally induced by transfer from trachoma cases. Four monkeys in each series had been previously inoculated with a vaccine of *Bact. granulosis* with the idea that the test might show whether there were immunological differences in the two conditions. In the "culture" series 5 of the 8 animals developed the granular condition after one swabbing from an infected monkey, and one after two swabbings, and one died. In all these the granular condition occurred spontaneously in the uninoculated eye. In the "direct transfer" series all the monkeys were swabbed 3 times (on consecutive days) and one of the 8 developed a granular condition in both eyes, 6 remained unaffected and one died. Of the 6 unaffected, 5 have since been swabbed from infected monkeys, one a single time, one 2

[1] K. L. Warren, SCIENCE, 76: 573, December 16, 1932.
[2] B. H. Walden, SCIENCE, 77: 91, January 20, 1933.
[3] F. L. Wells, SCIENCE, 77: 91, January 20, 1933.
[1] Ida A. Bengtson, *Pub. Health Rep.*, 47: 1914, September 19, 1932.
[2] J. Taborisky, *Graefe's Arch. f. Ophth.*, 123: 140, 1930.
[3] Ida A. Bengtson, *Pub. Health Rep.*, 47: 2281, December 9, 1932.