the resistance change of the solution in relation to its concentration.

II—A suitable absorption vessel with electrolytic resistance cell incorporated is illustrated and described.

III—Resistance measurements of barium hydroxide solutions varying in concentration from 3.08 g. $\text{Ba}(\text{OH})_2$ per l. to 42.25 g. $\text{Ba}(\text{OH})_2$ per l. were determined approximately, and determinations accurate within 0.01 ohm were made of the resistances of twelve different solutions varying from 5.820 g. $\text{Ba}(\text{OH})_2$ per l. to 7.300 g. $\text{Ba}(\text{OH})_2$ per l.

IV—Temperature coefficients of resistance of these twelve solutions were determined in the range 20.00° to 30.00° C.

V—Based on the measurements of resistance of the barium hydroxide solutions, solutions with concentrations varying between 5.820 g. $\text{Ba}(\text{OH})_2$ per l. and 7.300 g. $\text{Ba}(\text{OH})_2$ per l. were chosen as most suitable for this method.

VI—Special resistance-measuring apparatus was developed which simplified these measurements by dispensing with tuned telephones, high frequency generators, and balanced inductances and capacities.

VII—A convenient nomographic method of applying necessary temperature corrections to resistance measurements was developed.

VIII—The method permits of accurate determinations of carbon in steel (*i. e.*, within 0.01 per cent carbon), by the direct combustion method in 4½ to 5 min.

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BUREAU OF STANDARDS
WASHINGTON, D. C.

THE DETECTION AND ESTIMATION OF SMALL AMOUNTS OF CERTAIN ORGANIC NITRO COMPOUNDS WITH SPECIAL REFERENCE TO THE EXAMINATION OF THE URINE OF TNT WORKERS

By ELIAS ELVOVE

Received March 31, 1919

In connection with the sanitary control of munition establishments where trinitrotoluene¹ was employed, it appeared desirable to have a convenient

¹ The trinitrotoluene which is ordinarily employed is the 2, 4, 6 variety. The specimen of this compound which was used in this work was obtained by several recrystallizations from a mixture of alcohol and benzene of a very pure sample which was kindly sent to this laboratory by the Bethlehem Steel Company, of New Castle, Delaware. A melting point determination carried out in this laboratory, by Dr. J. M. Johnson, on a similarly recrystallized product showed the melting point to be 80.9° C. (corr.).

and fairly rapid method for the detection and estimation of small amounts of the trinitrotoluene in air. It was thought that the qualitative color test with alkali, which forms the basis of the so-called Webster¹ test for TNT in urine, might be developed into a quantitative method. As this test is ordinarily carried out, however, the color obtained is very fugitive and hence cannot well be utilized for making quantitative determinations colorimetrically. The best one can do is to follow the procedure of Webster, *i. e.*, adopt some arbitrary scale of one's own, such as "trace, 1, 2, 3, 4, and intense." It was primarily with the object of making this color test more nearly quantitative that this work was undertaken.

The Webster test to which reference has been made is carried out by first extracting the acidified urine with ether and then treating the extract with an alcoholic solution of potash. The latter is prepared, according to Webster, by dissolving 4 to 5 g. of caustic potash in 100 cc. absolute alcohol or by mixing 10 cc. of a saturated solution of caustic potash with 90 cc. of alcohol. Since these directions allow of a considerable variation in the concentration of the alkali and since in order to standardize the conditions it appeared desirable to fix more definitely the concentration of the alkali, some experiments were carried out with this object in view. An ethereal² solution of 2, 4, 6-trinitrotoluene was prepared containing 0.01 mg. of the trinitrotoluene in 1 cc. of the solution. A number of alcoholic³ potash solutions were also prepared containing different concentrations of the alkali. Each of 5 cc. portions of the ethereal solution was then mixed, at room temperature, with 5 cc. of one of these alcoholic potash solutions. The results obtained are given in Table I.

The results given in Table I show that the concentration of the alkali is a very important factor in controlling the stability of the color produced by the action of the alkali on the trinitrotoluene in the Webster test. They also show that by reducing the concentration of the alkali used by Webster to about that used in Expt. 3, we can obtain sufficient stability for the color to render it possible to utilize it for quantitative purposes.

In order to apply this alkali-trinitrotoluene color reaction to the detection and estimation of trinitrotoluene in air, it appeared best to substitute alcohol as the solvent in place of the much more volatile ether. In order, therefore, to determine the favorable concentrations of the alkali to employ when alcohol is used as the solvent for the TNT, experiments were carried out with varying concentrations of the alkali, using for each experiment 5 cc. of a solution of the trinitrotoluene in absolute⁴ alcohol, containing 0.01 mg. of the trinitrotoluene in 1 cc. of the solution,

¹ *British Med. J.*, 2 (1916), 845.

² The ether used was the ordinary ether of the quality described in the U. S. Pharmacopoeia.

³ Absolute alcohol or the ordinary alcohol which has been redistilled over lime was used in all this work. It was found that by using such an alcohol, instead of the ordinary 95 per cent alcohol, even the more concentrated alcoholic potash solutions were practically colorless when fresh.

⁴ The specific gravity of the alcohol used was 0.788 at 25° C.

and 5 cc. of an alcoholic potash solution, the concentration of the alkali varying in the different experiments. The results obtained are given in Table II.

TABLE I—EFFECT OF VARYING THE CONCENTRATION OF THE ALKALI ON THE STABILITY OF THE COLOR PRODUCED BY THE ACTION OF THE ALKALI ON THE TRINITROTOLUENE DISSOLVED IN ETHER

Expt. No.	Vol. of the TNT Soln. Cc.	Vol. of the Alcoholic Potash Cc.	Composition of the Alcoholic Potash ¹	APPEARANCE AND DURATION OF THE COLOR
1	5	5	90 cc. alcohol +10 cc. 10 N KOH ²	Decided purplish color, disappearing almost immediately after mixing
2	5	5	90 cc. alcohol +10 cc. N KOH	Very decided purplish color immediately after mixing, gradually fading, and nearly disappearing at end of an hour
3	5	5	90 cc. alcohol +10 cc. N/10 KOH	Very decided purplish color immediately after mixing. Distinct purplish color still remaining at end of 3 hrs. but nearly disappearing at end of 24 hrs.
4	5	5	90 cc. alcohol +10 cc. N/100 KOH	Very decided purplish color immediately after mixing. Distinct purplish color still remaining at end of 2 hrs. but practically colorless at end of 24 hrs.

¹ In preparing these solutions and carrying out these experiments the aim was to adhere as closely as possible to the procedure given by Webster. Hence all the alcoholic potash solutions were prepared by Webster's procedure with the only difference that the strength of the potassium hydroxide solution was varied in the different cases.

² This concentration is really less than that called for by the Webster procedure, since this solution was prepared by diluting a potassium hydroxide solution which was not quite saturated at the room temperature, whereas the Webster procedure calls for a saturated potassium hydroxide solution.

TABLE II—EFFECT OF VARYING THE CONCENTRATION OF THE ALKALI ON THE STABILITY OF THE COLOR PRODUCED BY THE ACTION OF THE ALKALI ON THE TRINITROTOLUENE DISSOLVED IN ALCOHOL

Expt. No.	Vol. of the TNT Soln. Cc.	Vol. of the Alcoholic Potash Cc.	Composition of the Alcoholic Potash	APPEARANCE AND DURATION OF THE COLOR
1	5	5	90 cc. alcohol +10 cc. 10 N KOH	Very decided purplish color quickly changing to orange, gradually fading, and nearly disappearing at end of an hour
2	5	5	90 cc. alcohol +10 cc. N KOH	Very decided purplish color, gradually fading, but still retaining considerable of the color at end of an hour
3	5	5	90 cc. alcohol +10 cc. N/10 KOH	Very decided purplish color immediately after mixing. Distinct purplish color still remaining at end of 3 hrs. and distinct pink at end of 24 hrs.
4	5	5	90 cc. alcohol +10 cc. N/100 KOH	Distinct purplish color immediately after mixing but nearly disappeared at end of 2 hrs.

The results given in Table II show that the concentration of the alkali is about as important a factor in controlling the stability of the color when alcohol is used as the solvent as when ether is used as the solvent for the TNT. Different concentrations of the alkali, however, do not in general have exactly the same effect on the color in the two cases. These results also show that in cases where the final mixture is largely alcoholic a concentration of the alkali corresponding to that used in Expt. 3 is very favorable towards increasing the stability of the color.

It was thought that from the point of view of

economy and also greater convenience, especially in field work, it would be desirable to reduce to a minimum the amount of absolute alcohol that would be required in carrying out the tests. Hence a series of experiments was carried out, similar to those above, with ether and alcohol, in which the solvent for the trinitrotoluene and also that for the alkali consisted of a mixture of alcohol and water in which the proportion of the latter was largely in excess. The concentration of the trinitrotoluene was the same as in the previous experiments, 1 cc. of the solution¹ containing 0.01 mg. of the trinitrotoluene. The results obtained are given in Table III.

TABLE III—EFFECT OF VARYING THE CONCENTRATION OF THE ALKALI ON THE STABILITY OF THE COLOR PRODUCED BY THE ACTION OF THE ALKALI ON THE TRINITROTOLUENE DISSOLVED IN A MIXTURE OF ALCOHOL AND WATER

Expt. No.	Vol. of the TNT Soln. Cc.	Vol. of the Alcoholic Potash Cc.	Composition of the Alcoholic Potash	APPEARANCE AND DURATION OF THE COLOR
1	5	5	20 cc. alcohol +70 cc. water +10 cc. 10 N KOH	Decided pink color, quickly changing to yellow, gradually fading, and nearly disappearing at end of an hour
2	5	5	20 cc. alcohol +70 cc. water +10 cc. N KOH	Slight pink color immediately after mixing, developing rapidly into decided orange, finally changing to yellow, and retaining considerable of this color at end of 24 hrs.
3	5	5	20 cc. alcohol +70 cc. water +10 cc. N/10 KOH	Almost colorless immediately after mixing but developing a slight pink color after standing 15 min., finally changing to a slight orange-yellow and retaining considerable of this color at end of 24 hrs.
4	5	5	20 cc. alcohol +70 cc. water +10 cc. N/100 KOH	Colorless

The results given in Table III show that the concentration of the alkali plays about as important a rôle in controlling the stability of the color when the mixture is largely aqueous as when it is alcoholic. It is to be noted, however, that the color which is thus stabilized is not the same in the two cases. They also show that a concentration of the alkali corresponding to that used in Expt. 2 is quite favorable towards yielding a color which can be readily utilized for quantitative purposes.

On the basis of the above results, the following procedure was adopted and used in connection with a study of the vapor pressure of TNT at different temperatures and also for determining the amounts of this substance present in the air of a munition plant² under various practical conditions. A definite volume of the air under examination was passed, by means of suction, through a series of three³ small

¹ This solution was prepared by diluting 10 cc. of an alcoholic solution, 1 cc. of which contained 0.1 mg. of the trinitrotoluene, to 100 cc. with distilled water.

² It is expected that the results of these studies will shortly be published in a Hygienic Laboratory Bulletin.

³ While the aim was to always have one tube in the series which would remain free from TNT in order to have direct proof that the absorption was complete, it was found that in reality, under the conditions which were studied, the absorption was nearly always complete in the first tube, so that the second and third tubes were nearly always free from TNT.

test-tubes¹ of about 11 mm. internal diameter, each of which usually contained 5 cc. of absolute alcohol. These tubes were connected by means of well-fitting rubber stoppers and glass tubing. The latter was arranged in the usual form of inlet and outlet tubes, each inlet tube nearly reaching the bottom of the corresponding test tube. A portion of the contents² of each tube,³ the amount depending on the amount of TNT it was expected to contain, was then transferred into a narrow-form, 50 cc. Nessler tube, and diluted with a volume of water equal to the difference between the volume of the alcoholic solution taken and 5 cc. Simultaneously, several standards⁴ were prepared containing known amounts of the pure trinitrotoluene, which were judged to be close to that of the unknown and having all the other conditions exactly the same as in the case of the unknown. 5 cc. of *N*/10 NaOH were then quickly added to the unknown and to each of the standards, allowing the alkali to run down the side of the tube. All the tubes were then shaken together, so as to mix the TNT solution and alkali in the different tubes as nearly simultaneously as possible. After standing 10 min., the resulting colors were compared in the usual way. The standards which were usually employed varied from each other, by increments of 0.01 mg. of the TNT, from 0.01 mg. to 0.1 mg.

APPLICATION OF THE GRIESS NITRITE TEST TO THE
DETECTION AND ESTIMATION OF SMALL AMOUNTS
OF TNT OR ITS HYDROXYLAMINO
DERIVATIVE

In examining the urine of TNT workers by the Webster test to which reference has been made above, in addition to the lack of a fairly quantitative basis, there is also the weakness of the test in that the coloration

which occurs may not be due to TNT since there are other substances¹ which produce similar colorations when treated with alkali. It seemed desirable, therefore, to have a confirmatory test for the TNT or its closely related derivatives in such urines, and preferably one which could be regarded as closely specific for these compounds. In this connection, it occurred to the writer that we might be able to apply the very sensitive and characteristic Griess nitrite test, which is ordinarily employed in water analysis, for the detection and estimation of small amounts of TNT or its closely related derivatives which still retain one or more of the NO₂ groups. Of course, the fact that the aromatic nitro compounds in general do not behave as esters of nitrous acid saponifiable by alkali, was rather discouraging to such an idea. A previous attempt along the same line with nitrobenzene, which was not successful, also tended to add to this discouragement. But it was felt that in the case of TNT, containing as it does three NO₂ groups, we stood an excellent chance of getting at least a partial reaction with alkali which would result in the formation of at least a very small amount of nitrite. And since the Griess nitrite test is so sensitive,² we probably would be able to detect it. Furthermore, even if this reaction should proceed only to a very slight extent, we might still be able to standardize the conditions so as to make this test not only of qualitative value but also fairly quantitative. Without going into the details of the preliminary experiments which were carried out, it may be stated that the results obtained indicated that the Griess nitrite test can be applied to the detection and estimation of small amounts of TNT. The following experiment will illustrate how this may be done:

An ethereal solution of 2,4,6-trinitrotoluene was prepared, 1 cc. of which contained 0.04 mg. of the trinitrotoluene. Portions of this solution corresponding to 0.01, 0.02, 0.03, 0.04, 0.05, and 0.06 mg., respectively, were carefully measured out, by means of a graduated 1 cc. pipette, and transferred into shallow 100 cc. beakers. The ether was allowed to evaporate at room temperature. To each residue there were then added 5 cc. *N* NaOH, the residue was detached from the beaker, with the aid of a glass stirring rod, and mixed with the alkali. The detaching of the residues from the beaker and the mixing with the alkali were effected in all the beakers as nearly simultaneously as possible by working the stirring rod in each beaker for only a few seconds and then proceeding to the next beaker and repeating this process until the residues in all the beakers appeared well detached and mixed. After the alkali had acted on the residue for 40 min., the contents of the beaker were diluted with 35 cc. water and acidified with 2 cc. of 5 *N* acetic acid. Each solution was then transferred to a 50 cc. Nessler tube and made up to the mark with water. The contents of each tube were then

¹ The reason for using a series of small test tubes rather than some special absorption apparatus was that by such an arrangement the scheme adopted would be elastic and adaptable to a greater variety of conditions as to temperature and rate of flow of the air, since we would be at liberty to increase or diminish the number of tubes; and by always having at least one tube remaining entirely free from TNT, we would always have direct proof that the absorption was complete. Furthermore, the simplicity of such an arrangement makes it especially adaptable for field work.

² Also the tubing through which the air has passed, especially the first inlet tube, should be washed with alcohol so as to dissolve the TNT which may have condensed therein. The TNT thus found is then added to that recovered in the other alcoholic solutions.

³ The tubes which are used for the absorption should have marks indicating the height of the column of the 5 cc. of alcohol taken, so that its volume after the absorption could be compared with that originally taken and proper allowance made in case there is any appreciable difference. Such a correction, however, was usually found unnecessary in the work to which this procedure was applied, as no marked change in volume occurred.

⁴ The standards were usually prepared as follows: 50 mg. of the pure trinitrotoluene were dissolved in 50 cc. of absolute alcohol, thus obtaining a solution, 1 cc. of which contained 1 mg. TNT. This was designated as Solution 1. 10 cc. of Solution 1 were then diluted with water to 100 cc., thus obtaining a solution, 1 cc. of which contained 0.1 mg. TNT. This was designated as Solution 2 and was the one generally employed in the preparation of the final standards, although in certain cases where the amount of TNT was comparatively very small, a standard solution of still greater dilution was similarly prepared from Solution 2. These standards were kept in a dark closet, since it was found that light causes the TNT solutions, especially those of the higher concentrations, to acquire color on standing. That Solution 2, however, is fairly stable when kept in a closed bottle in the dark, was shown by a comparative test with a solution which was prepared on May 6, 1918, and another similarly prepared on June 27, 1918. On the latter date, 1 cc. of each of these solutions was mixed with 2 cc. absolute alcohol and 2 cc. water. Each mixture was then treated with 5 cc. *N*/10 NaOH in the usual way. After standing 10 min., no appreciable difference could be observed in the colors of the two solutions.

¹ For example, it has recently been pointed out by Tutin (*Lancet*, Oct. 26, 1918) that "various purgatives (rhubarb, senna, cascara, etc.) contain substances which, when excreted in the urine, give, under the conditions of Webster's test, a red or reddish violet color, which might be mistaken for that produced by TNT."

² Capable of detecting 1 part of nitrogen as nitrite in 1,000,000,000 parts of water.

mixed with 1 cc. of each of the Griess nitrite reagents.¹ After standing 30 min., even the solution which represented only one-hundredth of a milligram of the trinitrotoluene gave a distinct test for nitrite in comparison with the control, and the amount of color in the above series of tubes increased with the increasing amounts of the trinitrotoluene which they represented. In other words, this experiment indicated that even as little as one-hundredth of a milligram of the trinitrotoluene could be detected by means of this nitrite test and that small amounts of it could thus be estimated colorimetrically.

According to the British investigators² of TNT poisoning, when TNT passes through the body it is converted into the 2,6-dinitro-4-hydroxylamino-toluene. It became of interest, therefore, to find out whether the nitrite test could also be applied to this compound. The preliminary tests which were carried out gave encouraging results, but it was found that the test, when carried out by the above described procedure, is not so sensitive in the case of the hydroxylamino derivative as in the case of the TNT itself. As the result of some further experiments, it was found that the nitrite test can be applied to the hydroxylamino derivative in a somewhat different manner from that described above for TNT, which yielded much more satisfactory results. This modified procedure consisted in treating its ethereal solution with the alkali instead of applying the latter to the solid. This modification was found to be especially well adapted for the application of this test to the urines of TNT workers. Without going into the details of the experiments which were carried out, it may suffice in this connection to simply describe the procedure which was finally adopted and used in the examination of the urines of TNT workers.

APPLICATION OF THE NITRITE TEST TO TNT URINES

The procedure which was finally adopted and used for examining the urines of TNT workers was carried out as follows: Placed 20 cc. of the TNT urine in a pear-shaped separatory funnel of about 250 cc. capacity and acidified³ with 10 cc. of 2 *N* H₂SO₄. Added 10 cc. ether and shook thoroughly for 3 min. Allowed to stand until the ethereal and aqueous layers had completely separated. Drew off the aqueous layer and washed the ethereal layer twice, using 2 cc. H₂O for each washing. Added 5 cc. *N* NaOH to the ethereal extract and shook thoroughly for 3 min. Al-

lowed the two layers to separate completely and then drew off the aqueous alkaline layer into a 100 cc. measuring flask. Washed the ethereal layer twice, using 1 cc. *N* NaOH for each washing¹ and adding these washings to the first alkaline extract. After a definite interval from the beginning of the first shaking of the ethereal extract with the *N* NaOH (usually 1 hr. or 2 hrs.), diluted the combined alkaline extract and washings with 50 cc. H₂O, acidified with 2 cc. 5 *N* acetic acid, and made up to 100 cc. with distilled water. Simultaneously with the work on the unknown, a series of standards was prepared by adding known amounts of an ethereal solution of pure 2,6-dinitro-4-hydroxylamino-toluene² to 20 cc. portions of normal human urine and treating these in exactly the same way as the unknown. The amount of nitrite in the final solution,³ obtained as just described, was then compared with the amounts found in the standards.⁴ Some of the results thus obtained are summarized in Table IV.

¹ In all washing operations the shaking lasted 10 sec.

² This compound was prepared in this laboratory, by Dr. J. M. Johnson, as follows: 50 g. 2,4,6-trinitrotoluene were suspended in 250 cc. alcohol, 1 cc. concentrated ammonia water was added, and hydrogen sulfide gas was run in. The mixture was cooled with ice at first but later allowed to warm up during the addition of the gas, which was continued for about 2 hrs. The insoluble portion was then filtered off, using suction. The filtrate was poured into water. A bulky yellow precipitate was obtained. This was filtered off and dissolved in hot 95 per cent alcohol, adding bone char and filtering hot. The crystals obtained on cooling were filtered off and then recrystallized several times from benzene containing a very small amount of alcohol, and finally from alcohol. The product thus obtained weighed 10.5 g. and showed a melting point of 135–136° C. (corr.) which agrees with the melting point obtained by Anschütz and Zimmermann (*Ber.*, 48 (1915), 154).

³ The amount of this solution to take for the nitrite test depends on the amount of residual color it shows. If this is little, 25 cc. of this solution may be taken for the nitrite test, diluting to 50 cc. with distilled water and mixing with 1 cc. of each of the nitrite reagents in the usual way. If, however, the solution still retains considerable color, a greater dilution is usually necessary before applying the nitrite test. In the cases of certain TNT dog urines which the writer had occasion to examine, as little as 2 cc. of the final solution had to be diluted to 50 cc. with distilled water before applying the nitrite test.

⁴ The standards which were usually prepared in connection with this work were those which represented the zero control, 0.1, 0.2, 0.3, 0.4, 0.6, and 1.0 mg. of the hydroxylamino derivative, respectively, in 20 cc. of urine. The 0.1, 0.2, 0.3, and 0.4 mg. standards were prepared by adding to 20 cc. portions of normal human urine 0.5, 1.0, 1.5, and 2.0 cc., respectively, of a freshly prepared ethereal solution of the hydroxylamino derivative, 1 cc. of which contained 0.2 mg. of the solid, and shaking until the ethereal solution was dissolved, acidifying each with 10 cc. of 2 *N* H₂SO₄ and adding a volume of ether equal to the difference between 10 cc. and that which was added as ethereal solution of the hydroxylamino derivative, thus making these standards exactly comparable with the unknown. From this point the unknown and standards were treated exactly alike by the above described procedure. The other standards were prepared in the same way with the only difference that for the 0.6 mg. standard 2 cc. of an ethereal solution of the hydroxylamino derivative (1 cc. of which contained 0.3 mg. of the solid) were used; and for the 1.0 mg. standard, 2 cc. of an ethereal solution of the hydroxylamino derivative (1 cc. of which contained 0.5 mg. of the solid) were used. Similarly, for the preparation of standards of higher value, ethereal solutions of the hydroxylamino derivative of corresponding higher concentrations were used, the maximum volume of the ethereal solution used for the preparation of any one standard never exceeding 2 cc.

It is important that the final comparison be made with a standard, the nitrite color of which does not differ much from that obtained with the unknown, since although in general the amount of nitrite in the final solution increases with increasing amounts of the hydroxylamino derivative, it is not exactly proportional to it. When, however, the nitrite colors of the unknown and standard are not very far apart (not differing more than about 20 per cent), no new standard need be prepared, but the estimation may be made by carefully pouring off into a suitable measuring cylinder sufficient of the more deeply colored solution until the colors of the two tubes match and then calculating the result, in the usual manner, from the proportion of the lengths of the columns of the solutions, the colors of which match.

¹ The reagents used consisted of a 0.5 per cent solution of α -naphthylamine and an 0.8 per cent solution of sulfanilic acid, using 5 *N* acetic acid as the solvent in both cases. See "Standard Methods of Water Analysis," A. P. H. A., 1917, p. 22.

² "The Causation and Prevention of Trinitrotoluene (TNT) Poisoning," Special Report Series, No. 11, Medical Research Committee of Great Britain, 1917, p. 18.

³ As a result of some experiments, it was found that it is unnecessary to use either as concentrated or as much sulfuric acid as is called for in the Webster test, in order to liberate the hydroxylamino derivative. A number of TNT urines which were treated by the above procedure were afterwards subjected to a second similar extraction, but no appreciable test for the hydroxylamino derivative was obtained in the second extracts, thus showing that by the above procedure the extraction is practically complete in the one operation. It is believed, however, that in general, 3 *N* H₂SO₄, in the same proportion as the 2 *N* H₂SO₄ which was used in this work, would be preferable, since that would allow a little greater margin for possible variations among different urines.

TABLE IV—SHOWING NITRITE-PRODUCING POWER OF SOME TNT URINES

NITRITE-PRODUCING POWER OF SOME TNT URINES			NITRITE-PRODUCING POWER OF SOME TNT URINES		
URINE No.	Designation of Worker	Nitrite-Producing Power of 1000 cc. of the Urine in Terms of the Hydroxylamino Derivative of TNT as the Standard	URINE No.	Designation of Worker	Nitrite-Producing Power of 1000 cc. of the Urine in Terms of the Hydroxylamino Derivative of TNT as the Standard
		Mg.			Mg.
1.....	LI — 48	3.9	31.....	MD — 375	3.4
2.....	LI — 638	21.9	32.....	SD — 531	28.9
3.....	SF — 231	12.4	33.....	MF — 793	12.1
4.....	LD — 8	7.7	34.....	KF — 392	29.7
5.....	LK — 16	40.0	35.....	LI — 48	21.7
6.....	LK — 401	38.5	36.....	LK — 192	69.9
7.....	LK — 87	12.1	37.....	LI — 496	17.8
8.....	SF — 205	5.0	38.....	LG — 601	75.7
9.....	SD — 524	1.8	39.....	LI — 638	36.3
10.....	MD — 733	7.4	40.....	LD — 46	33.2
11.....	MI — 133	5.0	41.....	LI — 208	33.2
12.....	SF — 248	2.2	42.....	LJ — 310	2.8
13.....	SF — 372	Negative	43.....	LD — 369	21.1
14.....	MJ — 613	5.0	44.....	LD — 40	107.4
15.....	MJ — 703	2.2	45.....	LD — 314	10.0
16.....	SD — 518	1.8	46.....	LK — 401	15.9
17.....	SD — 523	2.2	47.....	LE — 543	7.5
18.....	MK — 20	1.8	48.....	LD — 568	27.7
19.....	MI — 232	2.2	49.....	LI — 631	80.7
20.....	MH — 237	1.8	50.....	MK — 12	30.0
21.....	MJ — 519	7.7	51.....	MG — 457	26.0
22.....	MK — 195	18.8	52.....	MD — 461	20.0
23.....	ME — 217	31.5	53.....	LH — 615	41.1
24.....	MF — 56	2.9	54.....	SD — 429	21.1
25.....	SK — 146	Negative	55.....	MD — 505	137.0
26.....	MK — 153	3.4	56.....	MJ — 12	8.0
27.....	MG — 198	2.9	57.....	MI — 17	21.1
28.....	MH — 225	5.0	58.....	SK — 146	5.0
29.....	MI — 252	12.1	59.....	MI — 149	21.1
30.....	MF — 278	5.0	60.....	LG — 199	35.5

The results given in Table IV show that the degrees of variation in the abnormality of TNT urines, as measured by the nitrite test, even when dealing with a comparatively limited variety of such urines, are actually more numerous than the comparatively small number of degrees which we are given by the Webster scale referred to above. Hence it is apparent that the procedure which was used in obtaining the results given in the above table enables us to recognize and record differences which by the Webster scale we are unable to handle. The above procedure has also the further advantage in that all the results are expressed in definite amounts of a definite substance and thus enables us to compare the results of different investigators.

Finally, it may be stated in this connection that it is the writer's intention to extend the study of the applicability of the nitrite test to other nitro compounds. In fact, a comparatively large number of experiments along this line have already been carried out. The results obtained thus far indicate that not only can the nitrite test be utilized for the detection and estimation of small amounts of many nitro compounds, but it may even be utilized for distinguishing between different members of this group.

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LABORATORY AND PLANT

POTASH FROM KELP: THE EXPERIMENTAL PLANT OF THE UNITED STATES DEPARTMENT OF AGRICULTURE. PRELIMINARY PAPER¹

By J. W. TURRENTINE AND PAUL S. SHOAF
Received June 10, 1919

In 1911 Congress authorized the Bureau of Soils of the United States Department of Agriculture to investigate the fertilizer resources of the United States.² This authority was granted largely in recognition of American dependence on Germany for all of the large quantities of potash entering fertilizers and the highly undesirable state of affairs resulting from that depend-

¹ Published with the permission of the Secretary of Agriculture.

² The preliminary report of work done under this authorization was embodied in Sen. Doc. 190, 62nd Congress, 2nd Session, entitled "Fertilizer Resources of the United States," under authorship of F. K. Cameron, R. B. Moore, E. E. Free, J. W. Turrentine, W. H. Waggaman, C. L. Alsberg, W. A. Setchell, G. B. Rigg, F. M. McFarland, W. C. Crandall, E. C. Johnson, A. R. Merz, C. C. Darwin, J. G. Smith, and R. F. Gardiner. This document contained the result of surveys of certain of the areas of growing Pacific coast kelps and showed them to be of large potential importance as a source of potash. A second report was rendered embodying the results of surveys of all the main areas of kelp in American waters from the coast of Mexico to the northwest peninsula of Alaska and was published as Report 100, "Potash from Kelp," under the authorship of F. K. Cameron, W. C. Crandall, Geo. B. Rigg, and T. C. Frye.

ence. This authority was enlarged in 1916 by the enactment of legislation instructing the Bureau to develop methods for the commercial production of potash from an American source and carrying an appropriation of \$175,000. This enactment was consummated late in 1915 and had specific reference to the erection and operation of an experimental plant for the extraction of potash and other values from kelp, the most important source of American potash not under promising private development. The unexpended balance of this appropriation was made available for the fiscal year 1917-18, and in 1918 a new appropriation of \$127,600 was made.

In the fall of 1916 an investigation was made by one of the present writers, of the then incipient kelp-potash industry at that time under development due to a critical shortage of potash and the consequent extremely high prices, to see if this young enterprise bid fair to solve the problem of the establishment of a permanent industry and if the results at that time attained could be made to show aught as to the feasibility of the proposed permanent industry. Especial