COMMITTEE REPORTS

REPORT OF COMMITTEE ON COLORED GLASS CONTAINERS.

BY H. V. ARNY, CHAIRMAN.

I—PROGRESS OF WORK.

Since our 1927 meeting, the following progress has been made in the difficult task before us:

1. The Glass Container Association has approved of our plans and has authorized Dr. S. H. Ayers to extend his services and that of the Research Laboratory of the Association in conducting such investigations as are decided upon.
2. The American Drug Manufacturers' Association has appointed a committee consisting of J. C. Krantz, Jr., W. L. Scoville and D. I. Macht to coöperate with us.
3. The American Pharmaceutical Manufacturers' Association has also appointed a committee consisting of C. C. Doll, A. D. Holmes, Coleman Bardos, G. A. Calvin, E. T. Kirkland and F. L. H. Nason to coöperate with us.
4. The Corning Glass Company of Corning, New York has shown marked interest in our work and sent a representative to our May Conference.

As to this May Conference, an account of our meeting was published in our JOURNAL (June 1928, page 598) and at this time we need only to state that it was an all-day meeting participated in by representatives of the four committees cited above and by Mr. W. C. Taylor of the Corning Glass Company.

The result of our deliberations was the passage of resolutions expressing the opinion that the subject of the deterioration of pharmaceuticals and chemicals by light was worthy of further research and that a committee should be appointed to consult manufacturers of pharmaceuticals and chemicals as to the practicability of raising $2000 to institute a research fellowship under the supervision of Drs. Arny and Ayers to conduct the investigation. Chairman Arny of the Conference appointed as such a committee C. C. Doll, of the American Pharmaceutical Manufacturers' Association, Fitzgerald Dunning, of the AMERICAN PHARMACEUTICAL ASSOCIATION and J. C. Krantz, Jr., of the American Drug Manufacturers' Association. This committee has already started its work of correspondence and states that while a definite report is not as yet available, satisfactory progress is being made.

Our report of 1927, it will be recalled, was a rather lengthy summary of the bibliography of our difficult problem. During the past year a second installment of bibliography was sent out in the form of a mimeographed bulletin. As there has been a large number of calls for both the reprints of our 1927 report and for our 1928 mimeographed bulletin, the latter is appended to this report for possible permanent publication in our JOURNAL.

II—RECENT BIBLIOGRAPHY.

The bulletin mentioned above, issued on April 16th, was devoted mainly to a summary of the recent important work of Eisenbrand and of Coebergh.

J. Eisenbrand (*Pharm. Ztg.*, 72 (1927), 247), first discusses the well-known action of light on certain chemicals; the fact that red light has little action while blue light has distinct action; the modern views of this phenomenon in terms of wave-length; the fact that the shorter wave-length the stronger the action of chemicals; the time element involved; *e. g.*, that half the light strength for twice the time gives an effect similar to one unit of light strength for one unit of time; and finally that the average glass lets through only a small amount of ultraviolet rays, hence these are of lesser importance in the study of preservation of chemicals in glass containers.

The results of his spectral photometric study of the usual types of bottle glass are tabulated below; "A" meaning ordinary amber glass; "B" blue-cobalt glass; "C" green-iron glass; and "D" reddish violet-manganese glass. In each case the thickness of the walls of the flask was about 2 mm.

Transmission of rays.	A.	B.	C.	D.
Blue	8–20%	40–80%	50–80%	0%
Green	20–50%	16–40%	50–80%	0%

Yellow	50–60%	16%	50–80%	0%
Red	60–80%	10–80%	50–80%	Small per cent

As the blue rays are the most chemically reactive, the foregoing table indicates that ordinary amber, blue and green glass are practically useless as protectives, whereas the manganese-violet glass has distinct protective value. Eisenbrand closes his paper by citing the following practical but crude method of Bordier for studying the protective value of any glass flask.

Solution A.—Ten drops of 10 per cent tincture of iodine are mixed with 1 liter of distilled water. This solution has a faint amber color.

Solution B.—Three drops of 10 per cent tincture of iodine are mixed with 1 liter of distilled water containing a little starch paste. This solution has an attractive blue color.

Solutions A and B are placed in bottles of colorless glass and in the bottles to be tested. Two of the clear glass bottles containing the yellow and blue solutions, respectively, are kept in a dark place whereas the others along with the colored solutions in the bottles being tested are exposed to the same light under the same conditions. The fluids in the clear glass exposed to light will soon fade out; whereas those kept in the dark will be unaffected. Those in the colored glass bottles will be faded more or less according to their poor or good protective qualities.

J. Eisenbrand (*Pharm. Ztg.*, 72 (1927), 1275), discusses classification of light-sensitive chemicals and means of protecting these from harmful light rays.

As to light-sensitive chemicals, he notes that degree of sensitivity varies widely. Incidentally, he points out the anomaly that the German Pharmacopœia calls potassium permanganate light-sensitive, whereas it gives no directions for preserving the light-sensitive benzaldehyde from the action of light. He believes that since all chemicals are more or less sensitive to light, they should be grouped into three classes: (*a*) extremely sensitive to light, (*b*) sensitive to light; (*c*) slightly sensitive to light.

He then discusses the possibility of a survey of most medicinal chemicals as to light-sensitivity; recommending for this purpose a quartz lamp in preference to sunlight, since the former furnishes a uniform quantity of light, whereas sunlight is, of course, variable in quality. He suggests that the chemical under investigation be treated (*a*) with direct quartz lamp rays; (*b*) with these rays as passed through a thick plate of glass; (*c*) as passed through the customary light filters. As examples of such work he states that 0.1 *N* potassium nitrate solution after 1 hour of exposure to quartz lamp rays showed 2.5 parts per 1000 of potassium nitrite; whereas when the rays were passed through the glass plate, no nitrite was detectable in the irradiated solution. A second example cited was a 3 per cent solution of hydrogen dioxide which lost half of its strength after exposure for 1 hour to the direct rays of a quartz lamp and lost appreciable quantities of the dioxide by an hour's exposure to sunlight. These experiments clearly indicate that potassium nitrate is only slightly sensitive to light and requires no protection, whereas solution of hydrogen dioxide is very sensitive to light and must be protected.

As to determination of amount of deterioration produced by light, the examination of the treated chemical must be varied according to available methods of determination of value. In the two cases just cited volumetric analysis gave the information desired; in some cases spectroscopic readings are necessary and with some medicaments biological assays will be required.

As to protection of light-sensitive chemicals, Eisenbrand again recommends a violet-manganese glass. He expresses his opinion that only a small number of medicaments are so light-sensitive as to require such protection and that for most cases amber-glass containers serve satisfactorily. He further points out that a good protective glass possesses either what he calls a "steeply ascending spectrum" (example, amber glass; transmission 8–20 per cent of blue rays; 20–50 per cent of green rays; 50–60 per cent of yellow rays and 60–80 per cent of red rays) or else has a very low transmission value for all light rays (example, the violet-manganese glass which he recommends). He then expresses the need of a bottle glass that is somewhere between the amber and the violet. Finally, in the bibliography he quotes Fedotieff and Lebedoff (*Z. anorg. allgem. Chem.*, 134 (1924), 87), as authors of a paper discussing the composition of the four types of glass that he used.

Dr. J. B. M. Coebergh under date of August 16, 1927, kindly wrote your Chairman as to his work which has been published in full in a 30-page pamphlet, printed in Dutch. Steps are now being taken to have the pamphlet translated into English and published in full. Pending that time the following summary written in English by Dr. Coebergh himself is of interest and value.

Professor Dr. Kolthoff handed your letter from July 21st over to me and asked me to send you some reply.

I did some research work on the question on the preservation of medicinal chemicals against the influence of light. I think to have solved the problem by studying: 1, which kind of rays deteriorate the chemicals; 2, which kind of glass protects against those rays; 3, how glass bottles may be judged on their light-protecting properties.

I am sending you per book-post a copy of my publication which will give you full information about the method applied and also a short abstract of this publication. The publication also mentions the bibliography on the most important work, that was done before. I think, however, this was not of great value, save in this respect that I learnt from it how it had to be done.

With reference to the points named above I followed this way.

I. I exposed the chemicals to full sunlight and at the same time to separate parts of this light of known wave-length by means of light filters, to find out, if deteriorated by sunlight, which kind of rays caused this deterioration. After much useless work I found the following filters were useful for this purpose.

	Wave-length of light (transmitted by a layer of 4-cm. thickness) in millimicrons.
1. Quinine bisulphate 0.8 solution	408 to beyond 720
2. Copper sulphate 2% behind dark blue-cobalt glass.	350 to 480
3. Copper chloride 75 Gm. to 200 cc	450 to 560
4. Copper chloride 10 Gm. / Calcium chloride anhydrous 84 Gm. } to 200 cc.	495 to 610
5. Copper sulphate 8.8 Gm. / Potassium dichromate 9.4 } to 200 cc	550 to 645
6. Ruby glass	600 to ?
7. Potassium dichromate 0.125% solution behind dark blue-cobalt glass	700 to ?

The solutions were contained in flat rectangular white flasks of 4-cm. thickness.

Later on the quinine solution, which deteriorates quickly, was protected by a glass plate with a gelatin film containing 15-mg. esculine per square dm.

It will be evident that by means of these 7 filters the action of light can be studied in 8 well-limited parts of the spectrum, the deterioration by the ultra-violet rays being found from the difference between the action of full sunlight and that behind Filter 1.

Plate Spectra Nos. 12 to 25 show the part of the spectrum transmitted by each filter. Figure 2 shows the quantity of the special light that is transmitted.

With these filters I studied a number of chemicals and found that deterioration is produced in a very different way. Many of them are only affected by ultra-violet rays (page 58 letter *a*),[1] others by all kinds of rays (letter *k*), hydrogen peroxide by rays beneath 500 and beyond 600, etc.

Thus these chemicals have to be protected in a different way against the light influence.

It may be of some interest to mention that rays of every wave-length may attack chemicals. This is shown by projecting the spectrum from an arc-light on a layer of yellow mercurous iodide, which darkens over the whole range of the spectrum.

II. The second part of my study was directed on the light-protecting value of various colored glasses.

[1] These numbered references relate to the graphs found in Dr. Coebergh's original dissertation.

Part of the results is to be found on Plates II and III.

It is obvious from these plates that some types of amber glass (Plate II Nos. 72 and 76) do not even protect against ultra-violet rays.

Somewhat darker colored amber glass protects against rays beneath 430, heavy colored amber glass against rays till 500. This amber glass, however, is so dark colored that you can see about nothing through a bottle of it.

Green glass, not the ordinary bottle glass colored by iron but the yellow-green type, colored probably with copper and chromate, known as green signal glass, protects—if light colored—against rays under 430 (Plate III, Nos. 90–91 Creosotal flask), if darker colored against rays beneath 480 and beyond 620.

Good ruby glass protects against rays beneath 600—I add a graph showing against which kind of rays various chemicals should be protected and which protection may be afforded by various colored glasses.

I think light-colored amber glass is of little use, if darker colored, it protects better but is unsatisfactory. Green glass (signal green) with sufficient depth of color seems to me the best for all-around protection. The color is attractive and the glass is very transparent.

Ruby glass perhaps would be still better but it seems ruby flasks are not manufactured and are too expensive.

3. I did much work in vain to find a practical way for judging colored flasks on their light-protecting qualities, but I think to have reached a fairly satisfactory result.

A 1% solution of benzidine in chloroform becomes turbid in sunlight in about 40 seconds. This deterioration is caused only by ultra-violet rays beneath 408. Thus, if you expose such solution behind colored glass to sunlight and no turbidity appears within about $5^1/_2$ hours, the glass protects fairly good against rays till 408. Light-amber and light-green glass should meet this trial.

Photographic print paper is affected by all rays under 600, thus also by the rays transmitted by good green glass. These rays (480–620) can be eliminated by dark blue-cobalt glass, which transmits rays till about 470. A piece of photographic paper getting colored in sunlight in about one second (celloidin paper), covered with a strip of dark blue cobalt glass and exposed behind colored glass, if not darkened within 80 minutes, shows that the glass protects well against rays under 480. Dark amber glass and green glass of sufficient depth of color meet this test. The darkening of the paper can be judged best if it is covered by a strip of black paper with a little hole.

The same photographic paper should not darken within 15 minutes behind ruby glass.

I hope this may be sufficient to show, that a good deal of the work, you think necessary, is already performed. But there is still enough to be done! It may be that someone else finds a better way to reach the end, but I think the way which I indicated above is practical, so that it is not absolutely necessary to look for other methods. Meanwhile it may be perfected *e. g.*, the filters might be altered in this sense that each transmits in its own range a more similar percentage of the light. But this involves much quantitative determination by the quartz-spectrograph!

The influence of air, moisture and quality of glass (alkalinity) might also be taken in account.

I only tried the chemicals which should be protected against light according to the Netherland Pharmacopœia, 4th edition.

Many other chemicals and pharmaceuticals are still to be tested. In many cases the difficulty is how to judge the alteration if the color does not change.

Meanwhile I know that Professor Dr. N. Schoorl at Utrecht tried a good number of other chemicals.

Dr. Coebergh's personal communication was accompanied by a chart whch cannot be reproduced at this time. Put into words it may be condensed as follows:

LIGHT TRANSMISSION OF GLASS EMPLOYED.

Dark green glass	480–620 millimicrons
Dark amber glass	500–750 millimicrons
Light amber glass	430–800 millimicrons
Light green glass	430–800 millimicrons
Ruby glass	600–800 millimicrons

PROTECTIVE ACTION OF GLASS EMPLOYED.

	Below. (In millimicrons.)	Above.
Dark green glass	480	620
Dark amber glass	500	750
Light amber glass	430	800
Light green glass	430	800
Ruby glass	600	800

WAVE-LENGTH OF LIGHT DECOMPOSING CHEMICALS.

The Following Are Affected by Light of Wave-Length Shorter than 408 Millimicrons.—Acidum hydrobromicum, acidum nitricum, amidopyrina, camphora monobromata, chloroformum, hydrargyri tannas, iodoformum, physostigminæ sulphas and quinina and its salts.

Affected by Light Waves up to 450 Millimicrons.—Æther, hydrargyri chloridum mite, santoninum.

Affected by Light Waves up to 500 Millimicrons.—Aqua chlori.

Affected by Light Waves up to 550 Millimicrons.—Ferri pyrophosphas solubilis.

Affected by Light Waves up to 600 Millimicrons.—Acidum benzoicum, argento-proteinum, betanaphthol, hydrargyri iodidum rubrum, pyrogallol and resorcinol.

Affected by Light Waves up to 700 Millimicrons.—Apomorphinæ hydrochloridum, hydrargyrum iodidum flavum and phenol.

Affected by Light Waves below 450 Millimicrons and above 600 Millimicrons.—Bromoformum and spiritus æthylis nitritis.

Affected by Light Waves below 500 Millimicrons and above 600 Millimicrons.—Liquor hydrogenii dioxidi.

Affected by Light Waves above 600 Millimicrons.—Acidum hydrocyanicum and tinctura iodi.

Affected by Light Waves of Every Length.—Hydrargyri oxidum flavum, hydrargyri oxidum rubrum, liquor epinephrinæ hydrochlorici, phosphorus and phenol liquefactum.

Dr. W. J. Husa (*Drug Markets*, 22 (1928), 220) has published an admirable paper summarizing the work already done on the physical side of the problem entrusted to us.

III—CONCLUSIONS.

Mr. J. B. Krak of *The Glass Industry* is now engaged, during such leisure as he has at his disposal, in the English translation of Dr. Coebergh's thirty-page doctor dissertation and has kindly given our committee a carbon copy of the translation as far as it has progressed. He hopes to see the entire dissertation printed in English during the coming winter.

As the work of our special committee is merely begun, we suggest the continuance of the committee for another year.

CUBAN ANTINARCOTIC LEGISLATION.

Legislation is contemplated in Cuba restricting and regulating the dispensing of narcotics. The proposed measure is patterned after the Harrison Act and provides for registration of physicians and pharmacists and compels them to keep strict records; violations are punishable by fines and imprisonment.