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NOTE

Volume III of these Transactions, containing the Public Safety Sessions, the Statistics Section, the Education Division, and the Home Safety Session, is being mailed automatically to certain members of the National Safety Council who are believed to be interested in them. Any other member of the Council may receive a copy of Volume III without charge by requesting it.

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drugs, poisons, toxins, as far as their effect on living animals or patients is concerned, do not regard the glittering attractions of any single property as a sure index for the safety of the whole.

If you are physicians, using drugs for treatment, always inquire into the Therapeutic Index.

If you are chemists, bear in mind: "Margin of Safety."

If you are lawyers, great executives, captains of industry, do not commit the glaring fallacy of the deductive logic, *Non Sequitur*, which draws unwarranted conclusions from minor premises to complex wholes; or, if you pride yourselves on being scientific, beware of making hasty generalization from insufficient data, a fallacy of the inductive method,

If you are philosophers consider actions of drug in *tout ensemble*, not with an eye to single properties, but on the whole.

If you are moralists, I beg you bear in mind the famous dictum of the psalmist (Ps. 34:15), "Depart from evil" first, and only after that "do good"; or putting it in other language, "The ends don't always justify the means."

And lastly, if you are plain, honest men of business, I beg you to maintain a balance 'twixt your gains and losses in terms of toxicology. In handling chemicals and drugs, 'tis well to keep your books on double-entry basis, for every drug is also poison; you wield a two-edged sword. This is the message which Pharmacology brings to all those who have inscribed upon their banners, SAFETY FIRST.

CHAIRMAN WHITTEMORE: Because of lack of time this morning we shall turn the meeting over to general discussion of Dr. Macht's paper, at the same time that we discuss the next subject on the program. Mr. S. E. Whiting will talk to us on "Putting the Specialist's Ideas to Work in Our Plant."

Putting the Specialist's Ideas to Work in Our Plants

By S. E. WHITING

Assistant Chief Engineer, Liberty Mutual Insurance Company, Boston

Mr. Chairman and gentlemen: referring first to Dr. Macht's admirable address, it is certainly going to take us a couple of more years to put all of this particular specialist's ideas to work in our plants. However, we have already gained on this first contact with him a much clearer understanding than we had of the fundamental factors governing the action of poisons upon human beings,—an excellent basis for further progress in the safety man's fight against industrial diseases.

As some of you know, it has been my function in this Chemical Section, most inappropriately, to head up your Industrial Poisons Committee for several years. I do not assert that the subject itself does not justify you in maintaining such a standing committee, because the chemical industries themselves and certain products they sell for use in other industries are probably responsible for their share in creating this type of hazard in industry. You chemical safety men are as much concerned to avoid disabling a workman slowly through poisoning as you are to avoid disabling him quickly through traumatic injury and I feel sure your concern is no less because of the fact that in certain states, the employer, strangely enough, is not legally liable for disability caused by occupational diseases. For one example out of many, Pennsylvania does not require compensation for lead poisoning.

I do not know how important this disease hazard is compared with the other industrial hazards. Because of its intangible quality compared with machinery accidents, falls, etc., and because of its typically slow onset, an occupational disease does not always jolt us into as prompt corrective measures as it should. By

pure chance I noted a month ago one of the Haskin newspaper articles from Washington giving some Bureau of Labor Statistics data on this subject in "round figures." I should say they were distinctly round figures, possibly somewhat inflated. It is asserted that the direct economic loss from occupational diseases is about $2,000,000,000 per annum. Indeed the Bureau goes further and by including the loss of *future* earning power (derived from life expectancy factors) sets the annual loss at $6,000,000,000 and adds some two billions more for medical and hospital costs.

Now, of course, no one is trying to pin all of these figures onto the chemical or any other industry. They pretend to be all inclusive and doubtless are, from anthrax in tanneries to Klieg eyes at Hollywood. They even mention what was historically probably the earliest occupational disease,—what doctors call prepatellar bursitis or house-maids knee. So far as I can see, house maids knees seem more prevalent today than ever.

Growing Recognition

Practically speaking and coming right up to present date, I have gained the impression from discussions before this section and from my regular business connection that more and more recognition of these industrial poisoning cases is developing. As one specialist recently expressed it in the American Medical Journal, more new diseases are coming out in this occupational exposure than "in any other field of medical endeavor". What does the doctor mean by that word "endeavor"?

The newest disease that has been triumphantly discovered by our specialists is a real humdinger because the prognosis is extremely grave or in layman's language, the victim is sure to die. We had one such case this summer and we don't yet know what the State Accident Board will think of it because, of course, industrial causation is alleged. This particular man looked the picture of health but several months ago developed ring worm, a fungus skin disease of no great seriousness. He treated for it privately and cleared it up, but it came back at him repeatedly, still nothing more than a nuisance to a perfectly rugged young man. Then he took some X-ray treatments for the skin lesions and promptly flared up with severe inflammation. He was sent to a hospital and they examined his blood and they looked for the various types of white cells and could not find anything but lymphocytes. This meant nothing at all to the ordinary surgeon so we consulted a specialist, an internist they called him. He named the trouble right away,—agranulocytosis—and said this fine looking man would die. I did not believe it but, in spite of transfusions and every other effort at the largest hospital in Massachusetts, he did die. What was the cause? Nobody knows; the specialists say the etiology of this disease is unknown. The man worked at spraying under good conditions of ventilation. The solvents were largely other than benzol which entered the picture only as the denaturant of the alcohol with which the pyroxylin was moistened for safe shipment. What, if any, industrial causation or even industrial aggravation exists in this death case is up to the specialists and I await their decision with interest.

Changing Ideas of the Specialists

Certainly this Chemical Section cannot be accused of failure in giving forethought to these disease problems. For years your practice has been to seek authoritative medical men to address your meetings,—more so than any other Section of the whole Council. You have also initiated technical research on particular poisoning hazards. By association with you, I too have gained many ideas to put to work in our plants where a disease hazard might be present. My main trouble, however, has been to keep within sight of the procession of changing ideas our specialists are marshalling before us.

Take the treatment for chemical burns. Many of you recall how at Cleveland we were told by one specialist to neutralize; bicarbonate of soda wash for acid burns, acetic acid wash for alkalis and ammonia fumes for nitrous fume inhalation. The proof was as direct as an inorganic chemical formula. Then we went to Detroit and learned from another specialist that neutralizing (on skin burns at least) was all wrong and he proved it too by presenting the testimony of the rats themselves who had undertaken this research. We indeed were happy then because this greatly simplified our plant first aid,—one universal wash for every sort of chemical burn, ordinary tap water. Further research on eye burns arrived at the same conclusion.

This, I think, is a permanent step forward but we must not forget that the rinsing must be genuinely thorough. It may be the water should be warmed somewhat and may be some wiping action with a wet rag should be applied to secure this thoroughness. Nor should we forget that a few caustic chemicals are not water soluble and you must not then depend for saving the case upon a mere garden hose or shower bath. For example, carbolic acid is quite dangerous on the skin or in the eye and for this you should rinse with alcohol,—if you can place your hands on any of it. Nor am I entirely sure that we can completely abandon the old idea of neutralization. Surely an antidote has essentially a neutralizing action and I find that Underhill of Yale in his book on Toxicology issued in 1928 repeatedly suggests antidotes to counteract poisons.

New Hospital Treatment for Burns

As a side issue in our chemical burn discussions, we brought out at the Detroit meeting some evidence that the hospital treatment of such cases was changing. In fact our own speaker, Dr. E. C. Davidson, had developed a new method in his research at the Henry Ford Hospital and mentioned it briefly; the application of wet compresses of 2 per cent to 5 per cent tannic acid for from 24 to 36 hours followed by dry treatment only. This treatment precipitates the proteins in the burned area, eliminating toxic absorption and minimizing bacterial invasion as well as reducing scar tissue deformities wonderfully.

Of course this seemed to be none of our business as safety men, but we knew how often these extensive body burns had proven fatal—whether chemical burns, fire burns, or scalds—and we naturally want to be sure everything possible is done to help save any injured man, whether by the plant first aid or by the later hospital treatment. I make no apologies for transgressing on these hospital grounds. The fact is that some of them have so few industrial cases they are glad to get the plant man's viewpoint. So I have watched the extension in use of this tannic acid treatment on extensive burns and have gained the impression that more and more hospitals are standardizing on it, including some of the big metropolitan leaders in the field. I suggest you inquire of your own hospital as to their knowledge and practice in respect to tannic acid,—the whole matter is available to them in medical literature.

Appropriate First Aid for Burns

I come now to the real reason for this digression, the question of our own plant first aid technique for body burns. For years this practice has been largely the application of an oily salve or liquid to exclude the air and kill the pain somewhat. This was all right when the hospital would later use a similar treatment of oily dressing, but is it all right if the hospital is going to use aqueous tannic acid? It seemed to me it would not be all right; that the oil or petrolatum or whatever you used would tend to interfere with the tanning action or at least to delay treatment until the hospital surgeon had removed all of your first aid,—a difficult and

painful process. I have been asking the surgeons about this,—Dr. Sawyer of Eastman and others of the Conference of Physicians in Industry and Boston surgeons and Dr. Davidson himself. A few see no great importance to the point I raised, but most of them do and concede that the first aid should be some water-miscible treatment if tannic acid is to be the hospital treatment. One surgeon goes so far as to say that the best first aid would be to wrap the patient in a blanket soaked in tannic acid itself. This may not be practicable because the solution is not, I understand, a stable one. There are several burn ointments on the market, however, that are water-miscible: Tannoid, Hydro-Picric, and KY Lubricating Jelly. These are made by reputable concerns and there may be others available. I suggest you check up this matter fully in your own locality,—unless you are confident you have guarded infallibly against having one of these extensive burn cases that are so pitiful.

Lead Poisoning Therapy

Perhaps this section is not much interested in the newer ideas regarding lead poisoning—that almost classical subject. Yet some of you do use sheet lead in acid chambers and if so, you should watch out for this hazard when doing any welding or cutting of the sheet by flame,—an exposure that could easily lead to a dangerous acute attack of poisoning. Again, some of you doubtless manufacture lead compounds. I hope, indeed, your plant physicians already know the best treatment for lead poisoning. This was brought out by the fundamental research that was made at Harvard some years ago by Aub, Fairhall, etc., under support from the National Lead Institute. As a result we have several practical ideas that you can put to work in your plants where needed. The easiest channel of absorption was found to be by respiration of dusts or fumes. The other channels—ingestion and skin absorption—are less important in the usual types of lead exposure. The lead is disabling while in the blood stream and not when stored in the bones. The storing of lead in the bones and its re-mobilizing in the blood stream vary with the calcium metabolism, positive or negative. Any doctor now has direct guidance in treating such cases adequately if only he understands all that this research has brought out. Yet I still find—years after the research findings were published—repeated cases where the attending doctor does not use the best treatment. It is even quite conceivable in a case of severe acute lead poisoning that any immediate deleading treatment might precipitate a fatal outcome. Therefore, if any of you encounter this hazard, I suggest you make sure your plant physician and also the staff of the hospital you use are acquainted with this new technique on lead therapy. With these newer ideas too, you will understand how a man who has worked for years without disability under a slight lead exposure, is not necessarily faking if he develops lead symptoms shortly after he gets laid off.

Further Study of Benzol

I must pass up benzol. We had this question settled once only to find, at our New York Congress luncheon, that certain high authorities (but not all of them) fear there is more to be learned about it. I am glad to see that further research on the subject is now under way supported by the benzol industry itself,—the logical procedure. With the medical profession turning more and more to hematology or blood study for diagnosis of humanity's many ailments, we need to be sure of our basis for holding any chemical substance responsible for a lethal blood disorder. I do like also the attitude of this industry in giving its customers technical advice on ventilation based on direct plant tests with an interferometer. This service is free for the asking.

Inhalation of Dusts

On the dusty lung hazard, I suspect this section is not particularly interested. Other industries have the chief exposure to it. The specialists give it a variety of names; silicosis, anthracosis, siderosis, asbestosis and pneumonoconiosis. The "oses" mean the insurance company has to pay for it. I have been learning this, however, that we cannot depend on the chemist alone to tell us whether or not any particular dust is or is not dangerous. We have to hire another specialist that calls himself a petrographer. You see our lung specialist says the most dangerous dust is free silica, not combined silicates, and straight chemical analysis does not make this distinction. It makes a microscopic optical examination necessary. It was at our Rochester mid-year meeting that I got the straight dope on this free silica idea from Dr. Russell of the Public Health Service. The finer particles of free silica (only a few microns in length) are breathed right into the air sacs of the lungs. Particles of other substances are similarly deposited but are then gobbled up by certain white cells and carried away. The free silica is not, but stays there and is walled up by tissue. Some years later the silica becomes colloided, breaks through the wall and presents a nice culture medium of devitalized tissue for tuberculosis germs to breed in and there you are. So watch out for free silica dust or silicosis. Another test for the dangerousness of dusts was given me by Dr. Sayres of the Bureau of Mines. He has to approve the kind of rock that can be used for rock dusting of coal mines. He injects a sample of the dust into the peritoneal cavity of a guinea pig and in a week or so examines the peritoneum for fibrosis; if any, the dust is unsafe; if none, it is O. K. which reminds me that one specialist asserted we could get a fibrosis in the lungs merely from swallowing sand. Except for the next specialist I met scoffing at his idea, I was all set to cut spinach off of my menu.

Lapse in Industrial Poison Data Sheets

Some inquiry has been made in this Section as to why your Industrial Poisons Committee has quit on the job of getting out Industrial Poisons Data Sheets. While officially connected with these flyers of which the chief merit was brevity I hardly dared to mention them,—they so quickly became obsolete under the onset of new ideas from the real specialists. Logically, I am now dropping myself out of this activity (being Chairman of your Nominating Committee) and leave the issuance of further sheets in the capable hands of your retiring sectional Chairman, Dr. Greenburg. Of course, also, there is now a Health Section of the Council and Dr. Sappington is going to press every month or so with up-to-date articles of the same general type. I might mention the subject that finally stalled us two years ago on the run of data sheets: chlorine. The Poisons Committee could not agree as to whether chlorine was a poison or was not. The toxicologists said it was, the manufacturers said it was not. The real answer probably was a quantitative one, as Dr. Macht has just pointed out to you in discussing drugs in general. The manufacturers finally said that their case was proved by the fact that President Coolidge cured his cold by inhaling chlorine. Ever since we have been waiting to hear from President Hoover. If the toxicologists win out, the country will have to go into mourning.

New Treatment for Nitrous Fumes

I do want to trespass a bit more upon your time to mention nitrous fumes. The air seems to be clearing on this subject. I do not recall how many expert chemists in your industry have tried to persuade me that this hazard was exaggerated, that process were the really toxic fumes generated,—some higher oxide like N_2O_5 or "ordinary" nitrous fumes were harmless, that only in the rare disorder of a nitrating

whatnot. Yet we have been getting such cases every now and then with fatal outcome. We even had such a fatal case in an ordinary shop exposure,—a man cleaning a casting in a pail of nitric acid and outdoors at that. Now comes the Cleveland Clinic disaster and focuses attention again on this nitrous fume question. The immediate deaths are assigned to high concentrations of carbon monoxide, the delayed deaths to nitrous fumes from the decomposing film. The Chemical Warfare Service seems competent to speak from both chemical and toxicological standpoints. They tell us the fumes involved were nitrogen dioxide, NO_2, and nitrogen tetroxide, N_2O_4, both present in a reversible reaction in proportions depending on the temperature. The originally generated fume is nitric oxide, NO. (The harmless nitrous oxide, N_2O, is generated in negligible amounts.) On exposure to moist air, the nitric oxide is immediately oxidized to the dioxide or tetroxide and I do not see how a workman is likely to breathe the nitric oxide before it has been exposed to the air.

I hesitate about going into the details of this new therapy for nitrous fume poisoning. Your doctors should themselves study the medical literature on the subject. As Mr. Armstrong has mentioned, our section has just issued a Chemical Safe practices Pamphlet on "Nitrous Fumes." This includes the new hospital treatment and you will note that the old passive method is replaced by a new aggressive treatment. As before, and this is within the safety man's functions, all doubtful cases must be followed up over night because of the delayed onset of the really serious symptoms. It is safest to allow no exercise at all and to send the case in an ambulance to a hospital for observation.

Absolute rest and warmth are called for with prompt study of the blood (hourly hemoglobin estimations) to detect any increase in concentration. At the first hint that the blood is thickening, radical steps to hold it down are advised by the specialists. There are two ways to accomplish this and present authorities appear to differ slightly as to priority between them. The one is water or saline solution intake of from four to eight liters per day, intravenously if necessary. The other is venesection or bleeding to the extent of 350 to 800 cubic centimeters, depending on the severity of the case (and also, I suppose, on the heft of the individual involved). Now our pamphlet on the subject and also, I understand, Dr. Underhill, placed fluid intake ahead of blood discharge, whereas the Chemical Warfare Service report on the Cleveland Hospital Disaster gives priority to bleeding "for incipient or advanced" cases of this type of edema from gassing. The Warfare Service feels that the blood remaining after venesection will then withdraw fluid from the tissues to restore the whole volume to normal. If this means a reduction in lung fluid, it would seem to the layman an important distinction, especially since in critical cases oxygen administration is advised.

Perhaps this question of sequence is not of importance since both treatments follow each other closely or are even given at the same time. If a certain sequence is important, however, I hope our specialists will advise us definitely as soon as they can, because we all want to conquer this fume hazard if possible.

Of course, the question as to quantity inhaled still remains a factor in determining the damage done. It is stated by Henderson that nitrous fumes do not cause a spasm of the glottis (as strong chlorine does) and no particular pain accompanies their deep inhalation. This makes them all the more dangerous. Shallow breathing as a protection is talked about by practical men but I would be more inclined to train the workmen, in case of a spill or fume off, to hold their breath and beat or any direct handling of the exposed nitrating liquid should always include adequate respiratory protection, whether you think there is any danger or whether you it for the great outdoors. All necessary repair work in vats, on pipelines, etc., don't.

CHAIRMAN WHITTEMORE: I am going to ask Mr. Whiting to take charge of the discussion.

MR. WHITING: We have time to get into some discussion. Is there any body who wishes to discuss Dr. Macht's paper?

CAPTAIN G. R. G. FISHER (Illinois Manufacturers' Association, Chicago, Ill.): Doctor, could you explain why in the use of mercurochrome there have been several instances of salivation following?

DR. MACHT: I have never known salivation to follow the use of mercurochrome because salivation is characteristic of the symptoms of a solution of mercury in an inorganic state. Are you speaking of ingestion or local application?

CAPTAIN FISHER: Dr. Young of Boston reports salivation from mercurochrome.

DR. MACHT: It may be an idiosyncracy. I should have mentioned, for instance, the effect of extraneous substances on the absorption of heavy metals. You have an example in bismuth. Ordinarily you take bismuth by mouth, in soluble form, without any harm whatever, but in certain individuals once in a great many cases certain substances are present in the intestines, some claim certain bacteria, which will produce a breaking out of the organic compound or setting free of inorganic bismuth and symptoms of bismuth poisoning. So it is possible, but very improbable, that mercurochrome might undergo a similar change in extraordinary cases.

Idiosyncracies are very common in connection with every drug. That is rather unusual. I doubt whether salivation has come, and it has come perhaps only in an individual susceptible to salivation from some other causes which were mistaken for mercurochrome.

S. W. ASHE (Superintendent of Education & Welfare, General Electric Company, Pittsfield, Mass.): I presume you have had some experience with a material they call bakelite. While I am not a chemist, I believe phenol is one of the elements that is used in its manufacture. Now we use enormous quantities of it and we are troubled with a rash which the men get from it. I was wondering, in view of what you said today (of course, they say in some cases some people are subject to it), whether you have to get them way from using it and put other individuals in their places. I was wondering if that rash was a surface affection, or whether it was more of an absorption due to the phenol in the system which was working back.

DR. MACHT: I don't know anything about bakelite, and I should like to know whether phenol is present. I should imagine that phenol is not the cause at all, that it is simply one of the substances used in the manufacture.

MR. ASHE: I understand carbolic acid was used in the manufacture of bakelite itself. Perhaps some gentleman here knows and would help to answer the question. The thought I had in mind is that it might be something more than the surface infection: if it did have carbolic acid in it, are we getting absorption which aggravated it.

DR. MACHT: Not being experienced with bakelite at all, I should say that phenol has nothing to do with this phenomenon at all. It is probably ascribed to something else, or the whole substance itself produces an irritation of the skin in susceptible people.

CHAIRMAN WHITING: Dr. Smythe of the University of Pennsylvania is here. We should like to hear from him in the discussion of Dr. Macht's paper.

DR. SMYTHE (University of Pennsylvania): I think the general idea he brought out is a very important one, that there are so many factors involved in consideration of the harmful effects of any drug or chemical that it is often

a very difficult problem, much harder to solve than the layman realizes. When the problem is put up to us, often we find through our theoretical experimentations that we fall down in our work because we have overlooked some of the conditions of environment in the subject itself.

One thing that was not brought out is quite important in consideration of the possible harmful effect of chemicals and drugs, and that is the personal factor; not only the resistance or lack of resistance of the individual to the drug on the first exposure, but the possibility of sensitizing a patient or a worker. A worker may work with a certain organic compound and it may not harm him for some time. Suddenly after a long period of working with that compound he becomes affected. He is being hypersensitized by the action of that material, continued exposure to small quantities of it which has increased his sensitivity to that particular material and it becomes to him a poison, whereas to his fellow workers it is not.

We have to bear that fact in mind in our consideration of the effect of any harmful materials. Recently I have been going over the literature on skin irritants in industry for the Industrial Hygiene Section of the American Public Health Association, and that fact is brought out very strongly in the literature on chemical skin irritants, the importance of recognizing the factor of hypersensitization of the individual in considering the effect of drugs upon the individual. I do not think the time justifies my talking longer on Dr. Macht's paper.

S. M. Pratt (Brooklyn Edison Company, Brooklyn, N. Y.): I am an outsider of the section. There does not happen to be a sentence in Dr. Macht's paper this morning which is not applicable to safety. I believe it is the most potentially valuable paper I have ever heard in a safety conference, in that if it were possible to disagree with Dr. Macht's paper it would be difficult to select that portion with which to disagree.

Since we have no medical section and nobody to treat some of the problems in the industrial sections, if you could do some work on several substances in regard to resuscitation after monoxide poisoning, for instance, the use of a stimulant as such in supplement to resuscitation, if you could authorize and make possible experimental work on the question of treatment of a non-breathing patient with stimulants or with drugs, you would be contributing as much toward the salvation of persons that are fully overcome as any work you could do.

I have seen fifty dead men in the last two years in the treatment of whom, prior to their death, no one had the vaguest idea as to the truth of whether anyone should inject any drugs they use and no one has made authentic statements on it. Dr. Drinker of Harvard has made some statements which he uttered very guardedly. I have gone as far as I can in the reading of matter available on the subject.

First let me ask as to the availability of this paper outside of your section, and second as to any scientific basis for treatment of resuscitation with drugs.

Chairman Whiting: That is a very interesting viewpoint you have given us. I feel, however, that we in the Chemical Section cannot claim to be the appropriate medium for any research on the subject of true carbon-monoxide asphyxiation. There is a Health Section, and they might imitate it. Of course, if monoxide were a prominent hazard in the chemical industry, some of our men like Armstrong would be taking hold of it and forming a committee of experts to study the subject. I had an impression that we were being led already in that subject by the Resuscitation Commission of the American Gas Association of which Dr. Drinker is chairman. If he hasn't succeeded yet, perhaps nobody else will.

Have you anything to say, Dr. Macht, on the possible use, in CO asphyxiation cases, of a drug that may help in resuscitation work? Under the present technique, we use only oxygen plus carbon-dioxide.

DR. MACHT: I have been working on carbon-monoxide poisoning for several years. Then I rather relegated it to the future and published a short preliminary note on the subject in regard to an experimental method of treatment which is not generally known. It is not a form of drugs. The method pursued now is a perfectly scientific one and a useful one, but it can perhaps be rendered more useful by a supplementary measure.

I have been very much interested in the effects of radiation on the actions of drugs and poisons. I mentioned incidentally in my lecture that light may play an important role in connection with the action of drugs. For instance, it has been known for years that eosin, the dye, will kill certain small animals by permesia when exposed to light, but will not kill in the same concentration in the dark.

I published a paper sometime ago showing that quinine sulphate solution, which is fluorescent, is more effective therapeutically on the one hand and toxicologically on the other if you give a large dose, by injecting the animal when it is exposed to irradiations from a quartz lamp. I was interested to study the effect of ultra-violet rays on carbon-monoxide poison. We have not written up all the work in the whole study over a couple of years. I will tell you the status to which we have come.

If you take carbon monoxide blood in a quartz tube and expose it to ultra-violet radiations, you will find it will become dissociated; the carbon monoxide from the hemoglobin, which usually is very firm and is broken up very easily. To my mind the crux of the whole treatment of carbon monoxide poisoning is to hasten the dissociation of the union of the poison CO with hemoglobin, so that the hemoglobin can combine normally with a sufficient amount of oxygen. There is no doubt at all that certain wave lengths of ultra-violet rays will break up this CO hemoglobin in test tubes.

After having established and tested that by experimental methods (which have been published in preliminary form), this was followed by work on animals. I used rates first. I gave them inhalations of carbon monoxide. It is true the same thing holds good for illuminating gas. After giving two animals the same amount of carbon monoxide poisoning, we put one in the dark and the other in the light. We found that almost without exception the one in the direct sunlight with windows open, in other words, exposed to ultra-violet rays, recovered more quickly than the other. The other was apt to die. This was continued on rabbits, experimentally. In other words, you can hasten the elimination of the CO combination with hemoglobin by exposing the animal to ultra-violet rays. I intend to continue the work before I publish it in full.

I will say this in answer to your question: How can you get these rays to work in a living animal? They might work in a quartz tube, but will these short wave lengths penetrate through the skin? The older literature on the penetration of the ultra-violet rays will tell you that these so-called physiologically active rays, ranging from 4200 to 3600, penetrate only a very small fraction of a millimeter through the skin. All I will say is that work has been done by Dr. Anderson, who is head of the research department of Anocia Company, specialists in physics and medicines and penetration of ultra-violet. We published two papers in which we showed conclusively by every method available that ultra-violet rays do penetrate much more deeply than has formerly been supposed. That, of course, is in conformity with the marvelous therapeutic results obtained by physicians and biologists in the treatment of certain diseases,

such as rickets and tuberculosis. I have recently been working on pernicious anemia with these rays. They will penetrate.

I lecture to my students in this way: In carbon monoxide poisoning, I expose the body to the sunlight, give ultra-violet rays, and in addition to CO_2, Dr. Anderson's treatment, plus arificial respiration. These rays really do seem to have the effect of getting at the crux, the pathological mechanism of the whole thing.

Dr. Smythe mentioned idiosyncracies or sensitization. I should have mentioned this phenomenon but I could not touch upon everything. We speak of that with habituation to drugs, which is very important and both ought to be studied together. Some subjects are habituated and so are rendered less sensitive than others. For instance, in purgatives, we have to give larger doses. Other drugs, however, lead to sensitization even among alkaloids. After taking the drug a little while the patient is rendered more sensitive and he need not take as large a dose as originally. That will be true in certain poisons, too.

I am glad the other gentleman, Mr. Pratt, of Brooklyn Edison Co., has spoken a word of appreciation for my humble effort. I wish to say that I touched only on the salient features of the whole subject. Absorption of drugs is even more complicated than I have made it seem to you, and to get at the bottom of the whole thing we have to study the penetration of cell membranes, which involves the study of physics, biology and chemistry.

DR. J. S. MILLARD (Medical Director, Goodyear Tire & Rubber Company, Akron, Ohio): I should like to know if X-ray would be more effective.

DR. MACHT: X-rays are dangerous to play with. We know X-rays will produce changes in the blood and are harmful, and I should not recommend that they be tried for this purpose. We know that long ultra-violet, so-called therapeutic rays, are comparatively harmless. You can get a bad sunburn, but that is about all. The X-rays are more penetrating and we know they will produce a breakdown of blood vessels.

H. J. SEGRAVE (Mine Safety Appliances Co., Pittsburgh, Pa.): There is one poison which we are more or less inclined to speak of as HCN, hydrocyanic acid gas. It is said it has no real poisonous effect. I understand there is some indication lately that HCN is absorbable through the skin in rather high concentration, which would indicate that instead of a physical effect or effect in the molecular form, it is an ionized form of the poison. Have you any information that would help us along this line?

DR. MACHT: I suppose you speak of the salts and not the gas itself?

MR. SEGRAVE: The gas itself as used in fumigating, which is an industrial poison of some magnitude, I believe.

DR. MACHT: I should say offhand where the gas is present there would be enough absorbed through the respiratory mechanism that you need not to take into acount the absorption through the skin. There is a slight absorption even of KCN through the skin. You can get a local effect, but I don't know of a systematic effort. KCN is slightly anesthetic. There, I think, the danger would be in the formation of the gas itself and the inhalation. I don't think you need fear much absorption through the skin. The mucous membrane is penetrative to a greater extent.

MR. SEGRAVE: The company with which I am connected is interested particularly in protection with the ordinary protective devices. By use of a respirator we would expect that the respiratory system would be able to cope with the gas either by chemical means or protection of the air supply or some such thing. I believe the Bureau of Mines has done some work recently and I was looking for some information along that line.

DR. MACHT: I cannot give you any firsthand information, but experiments could be made very easily.

JOHN S. SHAW (Manager of Safety & Service, Hercules Powder Company, Wilmington, Delaware): Dr. Macht, this is a safety engineers' group and there might be some danger of our going home a little confused. What are we to use for first aid puncture wounds? Two per cent solution of tincture of iodine or mercurochrome? Which is the safer?

DR. MACHT: I should think, considering the action of an antiseptic in toto, not only bacteriologically but pharmacologically, the latter, given in sufficient concentration, would do all the work. An aqueous solution could be used. Acetone and alcohol solution has been recommended for hospital use, but a two per cent aqueous solution for first aid is not only bacteriostatic but bactericidal. I believe the limits of this dye are one to eight hundred. A two per cent solution of one to five ought to be sufficient.

I should recommend in all cases of puncture wounds and others to wash them out first, if possible, before applying anything, because if you have grease or oil present you have the question of prevention of absorption. If there is sufficient grease present an aqueous solution will not penetrate because it does not contain alcohol. Wash out with soap and water, if possible, and then apply your antiseptic.

MR. SHAW: Is two per cent tincture of iodine destructive to the tissue?

DR. MACHT: The regular tincture is seven per cent, but even one per cent of Lugol's solution, which is not tincture at all, while not antiseptic to an extent, is very markedly destructive to protoplasm.

MR. SHAW: Is this albuminate of iodine injurious to any of the organs?

DR. MACHT: I shall give you an experiment which I have made. Take a rabbit and paint its abdomen with tincture of iodine, a single coat. In half an hour you can show the presence of iodine in the urine. Before I painted the rabbit, I tested its kidney function with phenolsulphthalein, the regular test. A few days later this rabbit continued to show iodine in the urine, the kidney function came down from 90 to 37, and finally the rabbit died.

MR. SHAW: What should we do with sprains and joints? We paint freely with iodine over the joint.

DR. MACHT: Over small areas in healthy people, I think there is no objection. There you are not painting for antiseptic purposes. You want the counter-irritant action. You could use a mustard plaster or any other irritant in its place. We always have to choose the lesser of two evils. If a drug is a poison, the only thing I am pleading for is that you should bear the margin of safety in your mind. We have to take chances and do a little harm if the good which results will over-balance and the patient will get well eventually. I do not believe that painting iodine on a healthy person will produce nephritis.

CAPTAIN FISHER: Isn't it conceded that lead and mercury are even so?

DR. MACHT: This brings out another question which I should have mentioned, and that is interaction of drugs. That is a phenomenon that is also new in pharmacology, but of greatest importance. When two drugs are applied the result which you will obtain may not be explained always by a mere summation of the drugs. They may antagonize each other or one may potentiate each other. This phenomenon is known as synergism. We have many examples of this. For instance, take the two alkaloids, morphine and scopolamine. To give a certain dose of morphine you have a certain effect. Scopolamine, by itself, is slightly sedative, but if you give the two combined, and even in smaller doses, then each one separately, the combination pro-

duces the profound sleep known as twilight sleep. That is an example of synergism.

The two alkaloids are not similar in chemical structure. Each one attacks a different vulnerable point in the collective molecule of the tissue. Each one hitches onto a separate side chain and that is like knocking a person in the jaw and in the stomach below the belt at the same time. It is enough to put him out, but if you give a double dose of one alone he might survive. You are attacking two points. This is a very rough explanation of synergism. Whether there is a synergism of lead and mercury, it is doubtful. I cannot answer offhand unless I have experimental evidence.

H. C. Rogers (Grasselli Chemical Company, Cleveland, Ohio): We all know that some individuals are more susceptible than others, and often we have to apply an antiseptic to a workman who has a greasy and dirty skin. Isn't it possible by using a watery solution that you might ruin the job; whereas if you are using alcohol solution you are sure to get rid of the bugs?

We have used iodine for years and I have never known a man to become ill through the use of iodine, and yet it is possible in your experiments with an animal that in painting the stomach and one thing or another you might get a dangerous condition; whereas painting a scratch or a wound on a man's arm might be a minor affair. To me it is a question of being sure whether you kill the bugs or run the danger of having the man become ill. Just how great is that danger? You have to paint a very large area to get enough to do any harm.

Dr. Macht: I should say it depends on the size of the area, in the first place. In small areas, I mentioned when some one else raised the question, you will not get enough absorption to produce any serious poisoning. There you bring in the alcohol question, I mean using the alcohol tincture. Were you referring to the skin or to the wound becoming greasy?

Mr. Rogers: Say you have a greasy skin and get a cut on it. It is hard to cut grease with water, whereas we know that alcohol will cut it.

Dr. Macht: I think ordinarily the mercurochrome, as far as I know, will penetrate even if you have grease. I mention that in case of puncture wounds which are hard to get at and which might be hard to wash off. In case there is a great deal of grease it would be preferable to use the special solvent for your dye antiseptic that I mentioned before as 30 per cent acetone and 40 per cent of alcohol, which is a liquid solvent that will penetrate quite deeply. I think for most purposes the aqueous solution would be sufficient in case you have a grimy skin.

The difficulty in this: with the iodine and antiseptic, it is not so much the systemic poisoning but the local effect on the tissues. There is no doubt the iodine will cause superficial destruction of the cells and that will over-balance any greater bactericidal effect, because wherever you have dead tissues, after the antiseptic has disappeared from the field of application (and in the case of iodine that happens very rapidly) the dead tissue will be liable to putrefaction and reinfection.

S. W. Ashe (Superintendent of Education & Welfare, General Electric Company, Pittsburgh, Pa.): Doctor, is there any especial reason in the use of mercurochrome when you have scratches and cuts made from copper wires that there should be any infection in there even though the wounds are carefully treated with mercurochrome? I have noticed in copper scratches, even after treating carefully, that you are more liable to get subsequent infection.

Dr. Macht: I don't know of any, unless it is the interaction the gentleman

mentioned with other metals. Of course, inorganic mercury will percipitate on copper, but with an inorganic compound, I don't know.

MR. ROGERS: I should like to ask if there is any difference between gentian violet and mercurochrome.

DR. MACHT: Gentian violet has one field only. They use it in certain skin diseases. I cannot give you the information in regard to the specific bacteria involved. It has been found to have some desirable effect. It cannot be considered as a general antiseptic. It does stain and of course stays a long time in the tissues. I mentioned as an example of something acting over a long period of time by virtue of its penetration as a stain.

CHAIRMAN WHITING: Are there any other inquiries? We certainly appreciate Dr. Macht's coming from Baltimore to address us.

ADJOURNMENT

Wednesday, October 2, 1929

C. F. WHITTEMORE, Vice-Chairman
Western Electric Company, Chicago

The third session was called to order at nine forty-five o'clock by the vice-chairman, C. F. Whittemore.

VICE-CHAIRMAN WHITTEMORE: This morning our program is scheduled to start with a talk by Mr. J. I. Connolly, chief engineer of the Chicago Department of Health. Unfortunately Mr. Connolly could not be in two places at once. He had to attend a meeting of the American Public Health Association.

We are very glad, however, to have his assistant speak to us in his stead. Mr. Thomas J. Claffy, Bureau Chief of the Bureau of Sanitary Engineering, Chicago Health Department, will read Mr. Connolly's paper.

The Fire, Explosion and Health Hazards of Refrigerants

By JOEL I. CONNOLLY
Chief, Bureau of Sanitary Engineering, Chicago Department of Health

The hazards of mechanical refrigeration have been the subject of much discussion and of some newspaper publicity during the last few months. Some deaths and non-fatal injuries have occurred in this city, which this week welcomes the members of the National Safety Congress. These accidents have given a tremendous impetus to the movement initiated by others, some of whom are members of this organization, toward greater safety in the use and handling of refrigerants.

In this paper an attempt will be made to present the viewpoint of a municipal bureau, a portion of the Department of Health, to which is submitted the problem of protecting the people of the city from a rather newly recognized danger to health and life. I said "health" first, because usually a lifetime of impaired health is a far worse fate than the sudden loss of life itself. Because of the fact that progress in health and safety work is so frequently expressed in lowered death rates, the general public and occasionally we ourselves, perhaps, may overlook the fact that the protection of health is as important and as difficult a task as the prevention of unnecessarily premature deaths.

It is realized by every thinking person that mechanical refrigeration is here to stay. Let us hope it will be in a somewhat safer form than in the past. Its manifest advantages are recognized by the guardians of public health and safety as readily as by those whose business it is to make and sell and install the apparatus. Consequently its dangers must not be permitted to become serious and wide-spread enough to result in oft-repeated tragedies and thereby undermine public confidence in the use of this type of refrigeration.

In stressing health hazards, the Department of Health has never taken an antogonistic attitude toward mechanical refrigeration. On the contrary, the safeguards demanded by public officials should be regarded as a distinct aid to the industry, by helping to eliminate the unscrupulous and careless whose misdeeds react unfavorably upon good and bad alike. Reasonable and necessary restrictions upon installations of systems and upon the use of toxic refrigerants tend to prevent oppressive and unnecessary measures which might result from hysteria over avoidable accidents, and it has been our purpose to give the public the safety it demands