of the car. Among the drivers were Lorraine Barrow, Stead, Jarrott—who won the Ardennes Circuit race last year—Gras, and others. Madame Du Gast, who had the remarkable courage to enter the high-speed race, having already distinguished herself on other occasions, was greatly remarked with her long pointed racing car. The Charron, Girardot & Voigt racer has the same general appearance as last year's type with a long box front ending in a radiator. One of this year's improvements is a newly designed gear-box with direct transmission at the highest speed. Charron, with his two associates, who each mounted a car, were of course among the favorites. Alcohol was represented by a 110-horse power car of the Gobron-Brillié make, which was no doubt the most powerful in the race, but did not succeed in taking a good place. The motor has four cylinders, with two pistons per cylinder working in opposite directions. Steam was championed by the Serpollet and Chaboche cars, and of the former two new types were completed just before the race. Two of these machines give 20 horse power and the other two 40 horse power. These cars have somewhat the same construction as the racers used at Nice this year, but the exterior is considerably modified. The pointed front contains the water and gasoline tanks; the motor is placed in the center of the chassis and the boiler is now quite in the rear. Among the light-weight cars the Renault attracted the most attention as the winners of the Paris-Vienna race last year. These machines keep about the same design as before, with their triple-radiator mounted on each side of the pointed front. Marcel Renault and his brother Louis each mounted a machine. Another favorite was the Darracq light car, and this year's type is of low and square form, with a box front terminated by a radiator and containing a 4-cylinder, 30-horse power motor.

The start took place from Versailles shortly after 3 o'clock A. M., on the 24th of May, and no less than 200,000 persons left Paris during the night to reach the town or some point farther along the road. The continuous procession of cyclists in innumerable file, each carrying a Chinese lantern, together with the automobiles, nearly all of which had turned out naturally to see the event, gave a festive air to the occurrence. It was intended to run the first stage to Bordeaux that day, or 331.2 miles, the next to Vittoria, 127.2 miles, and the last to Madrid, 325.8 miles, making a total of 784.2 miles. Over 50 tourists had left Paris a few days before on their way to Madrid to see the finish as well as to test the endurance of their machines.

The machines were started one after the other in the order of their inscription, which had therefore no particular significance, as it was only the time occupied in making the run that counted. However, many of the leading champions had the first numbers. Shortly after 3 o'clock all was ready for the start, the road was cleared and the competitors were drawn up in file awaiting their turn. First in order came Jarrott on his De Dietrich car. At the signal given by the timekeeper, Jarrott came up to the line with his formidable machine ready to start. But it was still too dark to see the road plainly and so it was decided to wait a quarter of an hour longer for better light. After Jarrott came Réné de Knyff on his Panhard, then Louis Renault in his light car, and not far behind was Fournier, mounted on a Mors racer, then the long file of competitors. At 3:45 the signal for the start was given and Jarrott led off with a tremendous rush, disappearing in a cloud of dust. The other cars followed at intervals of one minute, and there were as many as 139 starters in the heavy and light weight classes. After these had all passed came the turn of the voiturettes, which were 36 in number, followed by 53 motor-bicycles which were started two by two in order to gain time. The greater number of spectators had left Versailles in order to see the cars pass at full speed, choosing the best places for watching the racers, some taking their position by a long stretch of road, others preferring the excitement of seeing the cars round a sharp turn at full speed. One of the best points lay at the foot of a long slope of good road between Versailles and Chartres, where the machines could be seen approaching from the top of the hill almost like specks in the distance, coming down with a terrific rush and passing at lightning speed. The sight was most impressive, and such high speeds have never before been attained under similar conditions. Unfortunately it will no doubt be a long time before such a performance is seen again in France.

Renault was the first to arrive at Bordeaux, at 12:14:0, followed by Jarrott, Gabriel, Salleron, Baras, Baron de Crawhez, etc. The race was won by Gabriel, who covered the distance in 5 h. 13 m. 31 s. Renault took second place in 5 h. 39 m. 59 s., which was a considerable surprise, as it was not expected that a light weight car would gain over so many of the more powerful racers.

The following is the official time of the winners, deducting for certain parts of the route where high speed could not be made, as in some towns and villages, which were not counted in the race. 1. Gabriel on a *Mors* car, time 5 h. 13 m. 31 s. 2. Louis Renault, *Renault* light car, time 5 h. 39 m. 59 s. 3. Salleron, *Mors* car, 5 h. 46 m. 0 1-5 s. 4. Jarrott, *De Dietrich* car, 5 h. 51 m. 55 s. 5. Warden, *Mercedes* car, 5 h. 56 m. 30 4-5 s. 6. De Crawhez, *Panhard* car, 6 h. 1 m. 8 2-5 s. 7. Voigt, *Charron, Girardot & Voigt* car, 6 h. 1 m. 9 1-5 s. 8. Gasteaux, *Mercedes* car, 6 h. 8 m. 0 s. 9. Ach. Fournier, *Mors* car, 6 h. 11 m. 39 s. 10. Baras, *Darracq* light car, 6 h. 12 m. 49 s. 11. Rougier, *De Dietrich* car, 6 h. 16 m. 7 4-5 s. 12. Moutier, *De Dietrich* car, 6 h. 17 m. 54 1-5 s., etc.

In the different classes, heavy cars, light cars, voiturettes and motocycles, the order is as follows: For the heavy cars the order is the same as above, leaving out No. 2 (Renault light car) and No. 10 (Darracq light car). For the light weight class the winners are: 1. L. Renault, *Renault* car, 5 h. 39 m. 59 s. 2. Baras, *Darracq* car, 6 h. 12 m. 49 s. 3. Page, *Decauville* car, 6 h. 19 m. 8 1-5 s. 4. Hemery, *Darracq* car, 6 h. 52 m. 33 1-5 s. 5. Pellésson, *De Dion* car, 7 h. 12 m. 43 1-5 s. 6. Théry, *Decauville* car, 7 h. 13 m. 16 s. 7. Edmond, *Darracq* car, 8 h. 0 m. 34 1-5 s. 8. Sincholle, *Darracq* car, 8 h. 4 m. 7 2-5 s. 9. Osmont, *Darracq* car, 8 h. 29 m. 40 2-5 s. 10. Bardin, *De Dion* car, 8 h. 30 m. 13 3-5 s., etc. The winners in the voiturette class are: 1. Masson (*Clement voiturette*), 7 h. 19 m. 57 1-5 s. 2. Barillier (*Geo. Richard*), 7 h. 39 m. 0 3-5 s. 3. Wagner (*Darracq*), 7 h. 47 m. 12 1-5 s. 4. Combier (*Geo. Richard*), 8 h. 7 m. 26 1-5 s. 5. Holley (*De Dion*), 8 h. 22 m. 19 s., etc. For the motor bicycles the order is as follows: 1. Bucquet (*Werner*), 8 h. 57 m. 1 s. 2. Demester (*Griffon*), 9 h. 3 m. 44 s. 3. Jollivet (*Griffon*), 9 h. 25 m. 54 2-5 s. 4. Cissac (*Peugeot*), 9 h. 39 m. 36 s. 5. Lanfranchi (*Peugeot*), 9 h. 50 m. 40 s., etc.

The first honor therefore falls to Gabriel with his Mors racer, and our engraving shows the winner as he crosses the line at the finish. Louis Renault, with the light-weight Renault car, confirms the victory of this type in the Paris-Vienna race, making the second best time, and the photograph shows him as he arrives at Bordeaux. The Renault car thus takes the first place in the light-weight class. The Mors racers also carry off third place with Salleron, which gives them a decided victory, even though some of their best drivers were not able to finish. Henri Fournier and Augières both had accidents *en route*, but were fortunately not injured, while Vanderbilt could not finish on account of a punctured tire. The Mors cars also took ninth place with Achille Fournier. The De Dietrich wins its laurels against the older machines, taking fourth place with Jarrott, while the Mercedes, although they certainly made a high speed on the road, did not come up to the general expectation, and only reached fifth place with Warden. The Panhard cars had still worse luck, as most of their best conductors had been disabled on the road owing to accidents, the Farman brothers and Réné de Knyff being *hors de combat*. The Panhard cars thus take sixth place with Baron de Crawhez. Another new machine to take a good place is the Charron, Girardot & Voigt, which now shows that it must be counted among the leading types, as it reached seventh place, mounted by Voigt. One of the Mercedes cars took eighth place, then came a Mors, followed by a Darracq light-weight car, which thus gained over the majority of heavy-weights. Most of the above mentioned machines are illustrated in the current issue of the Supplement, where a more detailed description of the various cars and the race itself will be found.

In the light-weight class Renault comes first in order, then the Darracq, both these cars making a good record. Then comes a Decauville, with another Darracq, and fifth a De Dion-Bouton. The voiturettes are led by Clement, followed by Geo. Richard and Darracq. Only eight motor-bicycles were able to finish. A Werner takes first place, mounted by Bucquet, followed by two of the Griffon type and two Peugeots.

As to speed, the results of the race were a surprise to all. It was expected that in view of the recent records which have been made on the road, the distance from Versailles to Bordeaux, or 331 miles, would be covered this year in 5½ hours, which would be a remarkable performance, since the Southern Express takes 7 hours to make the distance. But in fact the winner, Gabriel, covered the ground in 5 hours 13 minutes, which represents an average speed of 63.45 miles an hour, and this was kept up over bad stretches of road, over drains and crossings and the numerous obstacles which were encountered. As to the highest speeds which were made by the new cars, there is little doubt that many of them ran as high as 70 or 80 miles an hour over parts of the road, and it is probable that never before have such high speeds been attained by automobiles.

It is to be regretted that this splendid performance was marked by a number of accidents, both to the chauffeurs and the spectators of the race, and some of these were of such a grave character that the authorities were obliged to stop the race at Bordeaux, fearing that further damage would be done along the remainder of the route. The most painful accident was that of Marcel Renault, which resulted in the death of this well-known chauffeur and winner of the Paris-Vienna race. It appears that Renault was following close behind Théry, not far from Bordeaux, and waited for the most favorable moment to pass him. At this point were two turns in the road which are rather dangerous. In trying to pass Théry, Renault kept up full speed, but made too wide a turn and one of the wheels caught in a ditch at the side of the road and broke off short. The car went head down and turned completely over. Renault was thrown head first against a tree and had his skull fractured. He remained unconscious for some time and his recovery was hoped for, but he did not survive. The death of Renault is the most regrettable accident of the race, and has been deeply felt by those who esteemed him for his skill as well as his personal qualities. His machinist was also severely wounded. Lorraine Barrow had a serious accident shortly after leaving Libourne. While going at full speed a dog ran under the wheels, causing the car to make a terrible swing to the right, running it into a tree while at a speed of 60 miles an hour. The machinist, Pierre Rodez, was thrown against the tree and instantly killed. Lorraine Barrow was found in an unconscious state and sustained various injuries, but at last reports it is thought he will recover. Near Montguyon, Mr. Stead, who piloted a De Dietrich car, tried to pass another racer in front of him and a collision took place. Stead was thrown out, and although injured, is expected to recover within a short time. Madame Du Gast, after having passed among the first, stopped for nearly two hours to look after Mr. Stead and was thus considerably behind in the race. The machinist was killed outright. A number of accidents are reported among the spectators. A soldier named Dupuy and several others were killed. M. Georges Richard, the well-known automobile constructor, while conducting a racing car, ran into a donkey-cart and was thrown from his machine, but is only slightly injured. The car piloted by Mr. Terry, the American chauffeur, had a collision with a competitor and was completely burned, as the gasoline reservoir took fire. Details of this disaster are given in the current issue of the Supplement.

Owing to the numerous accidents, the authorities refused to allow the race to proceed further than Bordeaux.

SOME EXPERIMENTS WITH ACTINIC LIGHT.

BY J. W. KIME, M.D.

The light of the sun is composed of three distinct kinds of rays, luminous, heat, and chemical or actinic rays.

The visible solar spectrum extends from the red, having a wave length of about 0.76 micron, to the violet, having a wave length of about 0.40 micron. The ultra-red rays have a greater wave length, and the ultra-violet shorter wave length than those which lie within the visible bands of the spectrum. The chemical waves of light, with which we are chiefly concerned in therapy, lie principally in the blue bands of the spectrum, and have a wave length of about 0.49 micron to about 0.40 micron.

Since it is actinic light that produces the chemical changes in the silver salts in the sensitized plates and papers used in photography, we may thus readily ascertain those bands in the solar spectrum which are rich and those that are poor in the rays which we desire to isolate and utilize in the treatment of disease.

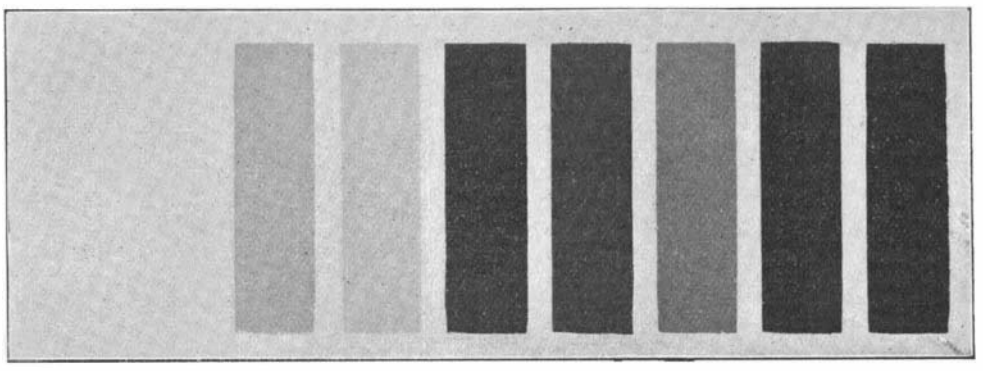
With this object in view, and with the able assistance of a photographer, Mr. G. L. Hostetler, the following experiments were made:

Experiment No. 1.—Strips of glass corresponding in color to the various colors of the solar spectrum were arranged as follows: Red, orange, yellow, green, blue, indigo, violet, open space, plain glass. These strips were fixed in a frame and were bound to a sensitized plate, after which they were exposed, almost instantaneously, to very weak, diffused daylight, which entered the dark-room without passing through glass. In this manner we obtained a true photograph of actinic light through open space, plain glass, and through glass of various colors.

Fig. 1 shows this result. We take the open space, in which no glass intervened between the light and the sensitized plate, as representing 100 per cent of the actinic light which reached the plate. Comparing this with that admitted through plain glass and through blue glass, we are unable to recognize any difference whatever between the open space and blue glass, while the plain glass is a shade darker, showing that less actinic light passed through it than through either of the other two.

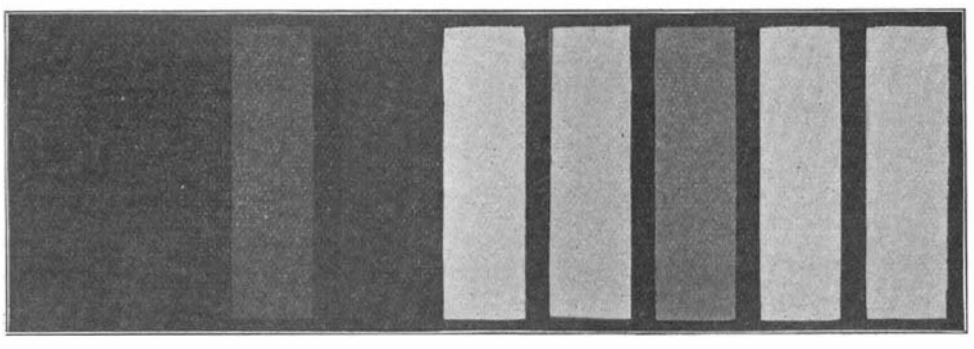
From this photograph it will be seen that blue glass cuts off no chemical light, and consequently that the ultra-violet rays are either not markedly actinic or that the blue glass does not retard their passage. It is very evident that 100 per cent of actinic light has reached the plate through the blue glass. Why the plain glass, which was perfectly transparent and of the same character as the imported photographic plates should be less translucent to the chemical rays than the blue glass I am unable to say, and I present the photograph

as the best evidence that the facts are as stated. Beginning at the red end of the spectrum, we find that no light whatever reached the plate through the red, and no trace is apparent in the orange; the yellow transmits an appreciable amount, and the green just enough to be seen. From this point we jump from almost zero in the green to 100 per cent in the blue. Hence wave length has nothing to do with determining the chemical activity of the light. In the indigo there is a slight diminution from the blue, but there is still fully as much as traversed the plain glass. In the violet we drop back to about the same percentage as in the yellow. Here we have shorter wave length with less chemical activity. We would infer from much that has appeared in recent literature that the violet and ultra-violet rays are those in which a maximum of chemical action may be found, that the higher we go in the scale, and the shorter the wave length, the greater the actinic power; or that the violet and ultra-violet rays contained other properties than those known in the other bands of the spectrum and other than luminous, heat, or chemical rays. It is apparent from our photographs that color, independently of wave length, influences the chemical action of light. The luminous rays have no effect upon the sensitized plate; the yellow band is richest in luminous rays, but it is very poor in actinic power. The red rays are rich in heat, but they are seen to be a blank in a chemical way; orange is rich in both heat and light, but it likewise is a blank in a chemotactic sense. Green is very bright, and transmits much light, but the chemical tracing in the plate is very slight. The blue is both cold and comparatively dark, in regard to heat and light, but it is exceedingly rich in an actinic sense. The plain glass transmits 100 per cent of light, or practically so, and about the same percentage of heat. but it is seen to be a little weak in a chemical way.



Red. Orange. Yellow. Green. Blue. Indigo. Violet. Open Space. Clear Glass.

Fig. 1.—A TRUE PHOTOGRAPHIC REPRODUCTION OF THE EFFECT OF ACTINIC LIGHT.



Red. Orange. Yellow. Green. Blue Indigo. Violet. Open Space. Clear Glass.

Fig. 2.—A TRUE PHOTOGRAPH OF THE EFFECT OF ACTINIC LIGHT ON SENSITIZED PRINTING-OUT PAPER.

Plate No. 2 is in every sense confirmatory of the conclusions drawn from plate No. 1, yet it was produced in a manner directly opposite to plate No. 1. The former is a positive, and the latter a negative.

Experiment No. 2.—The same strips of glass were arranged precisely as for experiment No. 1. They were now, however, placed over ordinary photographic printing paper, Aristo, and were exposed to the sun until the open space was fully printed. No other glass intervened between the sensitized paper and the sun except the strips referred to. This print being made through the glass of various colors represents the proportion of actinic light transmitted.

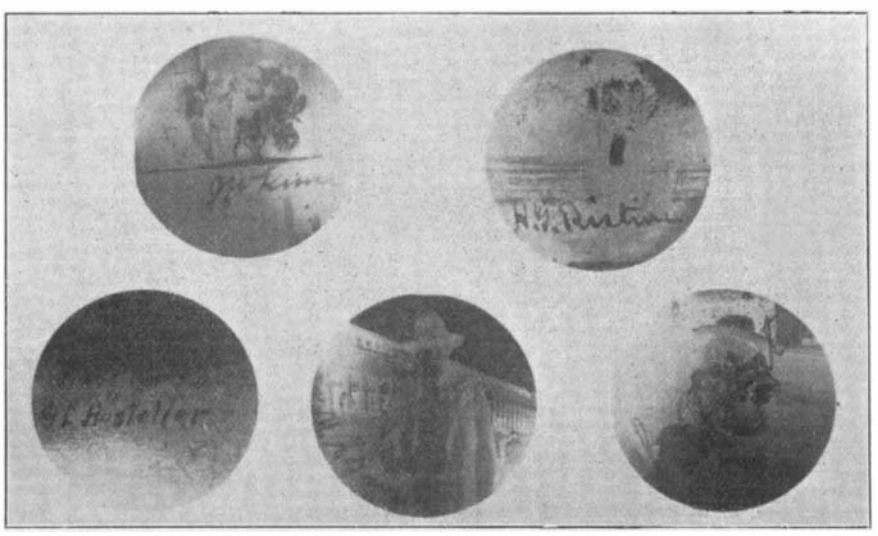
The red and orange each cut off 100 per cent; the yellow transmits a small percentage; in the green we drop back to merely a trace, while in the blue we rise suddenly to 100 per cent; the indigo transmits a little less than the blue, while the violet drops to less than 50 per cent of the blue. The open space transmits 100 per cent of actinic light, and, so far as we are able to see here, the plain glass also transmits 100 per cent of actinic light. (I consider the actual photograph on the sensitized plate the more delicate and accurate test of the two.)

In both plates 1 and 2 the violet band is shown to be poor in actinic light. Hence the so-called "violet ray," which is now so common in literature, should be dropped, and "blue ray" should be substituted in its place.

The results shown in plates 1 and 2 have been confirmed by repeatedly going over the experiments, and always with like findings.

Experiment No. 3.—Penetrability of Actinic Light.—That light may be of value in the treatment of disease, it must be made to penetrate deeply into the tissues of the body. For lupus, superficial epithelioma, and parasitic diseases of the skin, deep penetration is less necessary than in the treatment of disease that is more deeply seated, as in pulmonary tuberculosis.

With the kind co-operation of my professional colleagues I was able to make the following experiments: Small photographic glass negatives were cut to such size that they might readily be passed to the inside of the cheek. Across the face of these negatives the physicians wrote their signatures. In the dark-room sensitized plates of like size were bound to the negatives. Thus arranged the plates were put inside the mouth between the teeth and the cheek, and, with the mouth tightly closed and the nose and mouth covered with a black silk cloth, the cheek was exposed to direct sunshine on a February day for forty seconds, and perfect reproductions of the pictures and of the signatures were thus secured. In these experiments the negatives were placed on the side exposed to the sun and next to the cheek. The prints thus obtained are, of course, in reverse to the pictures on the original negatives, and are here reproduced as transparencies. I am



PHOTOGRAPHS TAKEN THROUGH THE CHEEK ON SENSITIZED PLATES HELD IN THE MOUTH.

under obligations to Drs. H. G. Ristine, W. R. Bates, A. H. McCreight, and W. Bowen and to Mr. Hostetler for assistance thus kindly rendered in this test. To make the test as rigid as possible, the same experiment was made in the same manner upon a very dark negro with a thick, black cheek. Time of exposure was the same as with the others.

The pictures arranged in their order are: J. W. Kime, bouquet of flowers; H. G. Ristine, man (negative); G. L. Hostetler, tree tops; W. Bowen, man and train of cars; W. R. Bates, boy sitting on steps; A. H. McCreight, a crowd at auction; negro, corner of porch.

Dr. McCreight has a thick, short, black beard, and the picture was taken through this as well as through the cheek. With the colored man the cutting off of the light by the pigment in the cheek was even more marked, but light still reached the plate and reproduced an imperfect picture. The other pictures are well marked, but would appear more natural were they in positives rather than in negatives. The signatures were reproduced perfectly through the cheek in most instances. No name was written on the last negative. No light reached these plates except that which passed through the entire thickness of the cheek. They are, therefore, positive proof that actinic sunlight will without concentration in forty seconds' time penetrate all the tissues of the cheek and reproduce a picture upon an ordinary sensitized photographic plate. No attempt was made to interfere with the free circulation of the blood through the cheek and the chemical light had also to pass through the glass negative to reach the sensitized plate. Since ordinary sunshine has such penetrative powers it is very evident that concentrated actinic sunlight, when concentrated as strongly as can be borne on account of the accompanying heat, penetrates the chest wall and the lung tissues to a very marked degree. That it penetrates the entire thickness of the thorax has been repeatedly shown first by the writer in 1900 and afterward by Gottheil and Franklin and Mount Blyer of New York and by Kaiser, of Vienna.

Thermometric Tests.—Sunlight was concentrated by means of a six-inch bifocal lens upon the bulb of a thermometer until the mercury rose to 168 deg. F. Strips of red, yellow, and blue glass were consecutively placed, so that the concentrated light must first pass through them before falling upon the bulb. When red or yellow was intervened, the mercury continued to rise; when blue was placed between, it fell. The difference marked was as high as 56 deg. F. Hence blue light is a very much colder light than that of any other color; and, since it is with the heat and actinic rays that we are most concerned in medicine—the heat to be eliminated in so far as it may be possible, and the chemical rays to be concentrated to the fullest extent—our experiments prove conclusively that these ends may be best attained by concentrating the rays which correspond to those found in the blue bands of the spectrum.

Passing the solar rays through blue glass excludes the heat to a marked degree, while the chemical rays are transmitted *in toto*. If these blue rays be then gathered up and concentrated either by a concave reflector or by a powerful lens, we have the richest possible light in chemical qualities and the poorest in regard to heat.

Our experiments show why red light is exceedingly valuable in the treatment of smallpox. They prove that no chemical light of any consequence reaches the patient; and since the chemical rays are irritant in their action, it is of the first importance that they be excluded.

No room in which a smallpox patient may hereafter lie should be left undraped with red cloth over every avenue through which light may be admitted. The plague of smallpox lies not so much in its mortality as in its frightful disfigurements, which, by the exclusion of chemical light, may be very materially lessened or wholly prevented. Either orange or green-colored drapings may be substituted for the red with very good results.

Finsen found that earthworms were restless under blue glass and were quiet under red; that chameleons partly under red and partly under blue glass soon changed the portion under the blue to a darker color and that under the red to a lighter color, the movable pigment being used to protect the reptile from the irritant action of the chemical rays of the blue. The red glass found in the photographer's window in the dark-room is another evidence of the non-penetrability of red to the actinic rays. Let him change this red pane to blue, and all his plates will be instantly ruined. Orange and green glass are sometimes used instead of red in dark-room windows.

The bactericidal effect of light is limited to its chemical rays, hence the blue and violet bands of the spectrum are those only that are of value in this respect, and the blue is much the richer of the two. It has been denied that actinic light will penetrate glass—that glass of all colors is impervious to it. We have shown that blue glass is perfectly transparent to these rays.

The penetrability of the chemical rays into the tissues of the body even when concentrated to the fullest extent to a depth beyond a few millimeters has been denied and it has been held that it is necessary to compress the parts to be treated in order to free them from blood, which, being red in color, absorbs the chemical rays. We have found, on the contrary, that not only the thick tissues of the cheek filled with blood, but even the black cheek of the negro, transmits the diluted rays of ordinary sunshine and still permits them to pass through glass to reach the plate. So simple have been all the experiments detailed, that any physician with the aid of a careful photographer may confirm them.