the satellites of some great planet, or the separation of a star from its companion, but his first enthusiastic study is almost sure to be the surface of that luminary which has all his days been an unanswered question. The student of nature is not content with the opinions of others when equipped with a first class telescope; he wants the personal "I see" upon which to base his opinions regarding a subject upon which so many conflicting arguments have been advanced.

He has learned that the moon's distance from the earth has been accurately measured, that its mass has been calculated and its density determined. These are facts which have been mathematically demonstrated. He has been taught that "figures do not lie," but he is often a little skeptical regarding the truthfulness of all the theories of those who have made the figures. He wants to go over the ground himself; and that there really is ground for him to go over is the one fact for the demonstration of which some proof is now offered. When contemplating a long journey, we usually study certain conditions which it is expected may be met with. But in our present case, of whom shall we inquire? By one careful observer we are told that the temperature of the whole country we seek is far above that of any place on the earth; in fact, that millions of years of unclouded sunshine, where the days are 354½ hours long, has changed the whole surface to a field of glass—that all water and air have been burned out of existence. Another tells us that the surface is a vast field of ice, and that there is plenty of the rarest kind of air. That, instead of crawling along, as we do here on the earth, pressed down by a load of fifteen pounds to every square inch of our superficial measurement, we would there be so cheered and buoyed up by our surroundings, that the heaviest person in our party would weigh less than thirty pounds. Competent engineers tell us, after careful measurement, they find that our journey would be one of more than 238,000 miles, a distance for the traveling of which a fast express train requires about three hundred days.

One of our party suggested that we should go early in the evening, as the moon must then be much nearer than when far up in the zenith. But that is a mistake. When the moon is just above our horizon, the length of our journey would be about 4,000 miles greater than when she appears highest in the heavens.

The moon looks nearer when on our horizon, because we compare it with terrestrial objects in the field of vision. To dispel the illusion, look at the rising moon through a tube which will shut other objects from the view. A newspaper or large sheet of wrapping paper, rolled to a diameter of one or two inches, will serve for the experiment.

Apparent size is often far from the actual. As an illustration of this, most of us would say that the moon looks as large as the sun. But in reality it contains only 1/400,000 part as much matter; this apparent similarity of size resulting from the sun being four hundred times further from us.

One of the most curious and interesting relations of the earth and moon is found in the rotation of the moon around its own axis in the exact time required to swing in its orbit around the earth; consequently the same side is always toward the earth. And if the moon had no libration, we would never see more than one hemisphere of its surface; but as the moon has a swinging motion, similar to that of a slowly rotating top, some little distance beyond her north and south poles becomes visible. If the moon is inhabited, what a field there is for the enterprise of some lunar Cook, or other energetic excursion organizer, who would liberally advertise trips to see the earth! The length of the journey from the center of the opposite side of the moon would be less than the distance between New York and San Francisco. He could very truly call the show a big one, and those who purchased his tickets would—when they came in sight of this world of ours—see an object more than fourteen times larger than any they had ever before looked upon.

A lunarian's walk by full earth light must be a very brilliant affair in a light such as we would get from fourteen full moons.

But time is passing, and each one must make his or her own calculations regarding the inhabitants of our satellite.

At the northwest corner of Second avenue and 11th street, in this city, stands a large, plain, well-built brick dwelling, which has during many years been the city home of a man known and esteemed among the great minds of his age as a leader whom it is safe to follow: a man, the best years of whose life, and a large part of whose ample fortune, have been devoted to the advancement of astronomical science.

To the older members of the section, it will doubtless seem quite appropriate that we are thus reminded of the first president under whom our meetings were held, Lewis M. Rutherford.

To Mr. Rutherford is due the credit of organizing the plans by means of which the trip to the moon, partially described to-night, was made possible.

Upon an ample lawn in the rear of the house before alluded to was erected, in the year 1856, one of the best private astronomical observatories of the time. The building is of brick, and in the main consists of a circular observing room, twenty feet in internal diameter, with a projection on the westerly side for transit and computing rooms. The twenty-foot dome of the observing room rests upon twelve wheels, equally spaced in the iron coping of the brick wall. The lower edge, or base, of the dome is fitted with a band of cogs, which gear into a chain-belted wheel, actuated by a crank in the wall of the observing room. So admirably is this mechanism constructed, that the strength of a child is sufficient for setting it in motion.

On two opposite sides of the dome from base to apex are openings, two feet in width, which are closed by shutters easily worked from below, and so devised as to screen the room from wind when open.

In the center of the room, resting upon a firm foundation, deeply embedded in the fine sand underlying the whole building and grounds, stands the telescope pier, a broad, high block of stone, and around this, but not in contact with it, is laid the floor.

In the transit room, 189 feet northwest of Second avenue, and 76.3 feet northeast of 11th street, the transit pier was erected.

The principal instrumental furnishings of the establishment consist of a first-class equatorially mounted telescope of 13 inches aperture and 14 feet focal length;

the readings of position are upon 18 and 20 inch silver circles.

The driving power is a Remontoir escapement clock of the highest merit. So accurate are its movements that the photographic image of faint stars, requiring long exposure, have a wonderful sharpness of outline.

The photographing of celestial bodies, attempted at various observatories previous to 1863, left much to be desired in definition. From some experiments made by Mr. Rutherford about that time, in connection with a government expedition, he was led to believe that a lens could be so constructed as to greatly improve astronomical photography, and, by a purely scientific method, he began his work of solving the problem.

By the use of the spectroscope he found that a lens of crown glass, so constructed as to shorten the focus of the observing telescope about 1/5, gave promise of good results. Through the use of specially devised mechanism and methods of trial—the description of which would require too much time—he constructed with his own hands such a lens. Only those who have attempted to grind, polish, and correct a 13 inch lens can well understand the labor involved in such an undertaking.

When, on the night of March 6, 1865, this newly devised method was proved to be correct, by the production of the first really good photograph of the moon, it was at once expected that photography would occupy an important position in science, and add greatly to the advance of astronomical observation.

That such expectation has been and is now being realized no one questions.

Within the next few days will be held in Paris a congress of astronomers for the express purpose of apportioning the labor of making a photographic map of the entire heavens, and it is expected to complete the work within ten years, and that these plates will show a vast number of stars which no human eye has as yet seen, even with the aid of the most powerful instruments.

Certainly, we may be pardoned for expressing a little pride in the fact that all this has begun more than twenty years ago by a citizen of New York and a member of our section of the American Institute. From his observatory we started for the moon, or, rather, under its great revolving dome found means for pulling the moon down, to be hung on the wall for our inspection.

Our party consisted of three persons, whom we will designate as numbers one, two, and three.

At 10.30 P. M. number two entered one of the computing rooms across the lawn and called "time," by reporting the zenith clear and the air still favorable for first-class work, a coincidence averaging about twice a year in New York City.

Upon this announcement numbers one and three bundle up in heavy clothing as though about to visit the north pole. They know the weather is crisp and cold where the next few hours are to be passed.

As they enter the door leading to the dome, under which stands the great equatorial, the silence is broken only by the escapement wheel of the tall sidereal clock standing against the western wall, as its heavy pendulum swings to and fro with an accuracy most wonderful.

No other sound. Not a word is spoken; each knows his assigned duty, and to it he gives his undivided attention. All feel that such time is beyond value, and must be utilized to the fullest extent.

Number one has charge of the telescope. The dome is revolved into position, and a long, narrow section, from base to apex, swung open, leaving a strip of clear sky visible, in the center of which the moon glistens like a disk of burnished silver. The great instrument is swung into approximate position; the driving clock, constructed to run one hour, is wound; and while number one is busy making his final adjustments, we will watch number two, who has charge of the photographic department of the expedition. He has lifted a trap door in the floor near the stone pier, passed down a short ladder, and entered what may well be called a troglodyte's laboratory, lighted by one small wax candle, as care is necessary to keep the temperature low. After a few minutes the pupils of his eyes are expanded sufficiently to permit seeing the bottles, baths, and dishes required for his work. But we have no time to describe his chemicals or his method of using them.

Meanwhile number three, the timekeeper, has adjusted the chronograph (in whose record there will be no personal equation), placed his small, dim lights where they will illuminate the clock and the room just enough to see what is going on, and then taken his position, where he can hear distinctly the beat of the long pendulum, as its lower end, terminating in a hair-like wire, swings at each vibration through a glistening drop of mercury, closing the battery current uniting chronograph, clock, and shutter adjustment on the telescope.

All is now ready for action. Upon a signal being given by number one, a sensitized plate is handed up from the cave, placed in its receptacle at the ocular end of the great instrument, just as it would be put into an ordinary camera.

The touch of an electric button, and away we go, or rather, we all keep very still.

The great clock says one, two, three, and the plate holder is opened to the light of the full moon, whose image the great glass eye, fourteen feet away, has condensed to a circle of 1 1/2 inches. The buzz of the chronograph wheels is just audible as it records the time in hundredths of a second. The heavy pendulum has beat one, and the long focused eye is closed, the plate holder is returned to the troglodyte, who reaches from below to receive it, as he hands another up.

And so the work goes on until early morning, when the weary and thoroughly chilled party seek rest in a comfortable temperature and among surroundings which their animal natures deem far more enjoyable.

One of the old Hindoo systems of theology taught that the souls of men could leave their bodies for short periods of time in quest of knowledge, where no human body could ever go, and upon their return, by imparting to their fellow men the wisdom thus gained, an endless existence of perfect happiness was secured.

Thus wise must have been our trip to the moon. The mind or soul reached out with a question. Was it answered? Let us see if any knowledge gained can be imparted to others.

[Then followed the lantern exhibition of many slides, shadowing the moon's surface; its mountains, more than twenty thousand feet high; its craters, fifteen and eighteen thousand feet deep, and from one to three hundred miles in diameter, were graphically described, and an explanation of the various theories advanced regarding the existence of air and water on the moon's surface; and some of the arguments used in support of such theories were examined. Dr. Mason closed his paper and description of the work done at the observatory by expressing regret that the telescope had been recently placed in the observatory of Columbia College, where he feared vibration would prevent its use for fine photographic work.]

THE ACTION OF FERRIC SULPHATE ON IRON.

By ALBERT E. MENKE.

THE deleterious action of ferric sulphate on boilers has been the cause of much trouble to engineers, owing to the fact that it appears to cause rapid corrosion. Experiments have been made to determine the action of ferric sulphate in solutions of different strengths on different irons, and to see how far it is possible to stop the destructive effects. In the first series of experiments pure iron wire was taken, a certain amount of water and ferric sulphate added, and the whole then heated in flasks with reversed coolers. For purposes of comparison, blank experiments were made with iron and water, leaving out the ferric sulphate. The following results were obtained:

No. of Expt.	Actual Loss.	Calculated on Blank.	Rust Formed.	Amount Fe(SO ₄) ₃ Used.	Weight Fe Taken.
1	.0135	.0133	.0002	.0016	1.1515
2	.0115	.0111	.0004	.0032	.9590
3	.0130	.0112	.0018	.0048	.6660
4	.0193	.0128	.0065	.0064	1.0965
5	.0161	.0108	.0053	.0080	.9314
6	.0214	.0135	.0076	.0096	1.1720
7	.0198	.0122	.0076	.0144	1.0507
8	.0040	.0032	.0008	.0016	.2816
9	.0080	.0033	.0047	.0032	.2805
10	.0050	.0036	.0014	.0048	.3136
11	.0030	.0028	.0002	.0064	.2440
12	.0035	.0026	.0009	.0080	.2295
13	.0036	.0028	.0008	.0096	.2464
14	.0070	.0032	.0038	.0144	.2800
15	.0030	.0030	.0030	None.	.2584
16	.0029	.0029	.0029	None.	.2576

The results in Column 3 were obtained by calculation from Experiments 15 and 16. All were heated the same length of time—fifteen hours. It will be noticed that there is a slight increase of oxidation as the strength of the ferric sulphate increases. The next set of experiments was made with the substances inclosed in sealed tubes and heated to 110° C. for fifteen hours.

No. of Expt.	Amount Rust Formed.	Fe ₂ (SO ₄) ₃ Used.	Weight Iron Taken.
17	.0005	.0016	.6930
18	.0006	.0016	.7390
19	.0008	.0032	.7860
20	.0005	.0032	.7.30
21	.0010	.0048	.8350
22	.0015	.0048	.7700
23	.0002	None.	.7900

It will be noticed here, again, that the rust increases with the ferric sulphate. In the next set of experiments, Nos. 24 and 25 had nothing but the iron and ferric sulphate solution, Nos. 26 and 27 had the calculated amount of sodic carbonate, Nos. 28 and 29 the potassic carbonate, and Nos. 30 and 31 the calcic carbonate requisite for decomposing the ferric sulphate. These experiments were made in sealed tubes heated to 110° C. for fifteen hours. The results are interesting, and show that the alkaline carbonates have a good effect in stopping the formation of rust.

No. of Expt.	Amount Rust Formed.	Fe ₂ (SO ₄) ₃ Used.	Weight Iron Taken.
24	.0025	.0093	.9596
25	.0028	.0093	.9331
26	.0010	.0093	.9318
27	.0011	.0093	.9166
28	.0010	.0093	.9504
29	.0006	.0093	.9431
30	.0023	.0093	1.0178
31	.0024	.0093	.9666

In the next set of experiments the temperature was raised to 160° C., the tubes being heated, however, only three hours.

No. of Expt.	Rust Formed.	Fe ₂ (SO ₄) ₃ Used.	Weight Iron Taken.
32	.0012	.0934	.8898
33	.0004	.0934	.9192
34	.0006	.0934	.9564
35	.0005	.0934	.9340

The action here has been more rapid as the temperature and pressure increased. The next series of experiments was made with boiler iron of good quality. The pieces of iron used were about one-half inch long, one-eighth inch thick, and one-eighth inch wide. The action was not as vigorous as in the experiments with pure iron.

No. of Expt.	Rust Formed.	Fe ₂ (SO ₄) ₃ Used.	Weight Iron Taken.	Remarks.
36	.0101	.0934	7.2561	Alone.
37	.0089	.0934	8.6119	Alone.
38	.0045	.0934	9.1265	+NaHCO ₃
39	.0035	.0934	8.8775	+NaHCO ₃
40	.0040	.0934	9.6142	+K ₂ CO ₃
41	.0030	.0934	7.9619	+K ₂ CO ₃
42	.0046	.0934	8.9392	+CaCO ₃
43	.0046	.0934	7.5256	+CaCO ₃

The above experiments were conducted in sealed tubes heated to 110° C. for 15 hours.

The next set of experiments was made in sealed tubes heated to 160° C. for 3 hours.

No. of Expt.	Amount Rust Formed.	Fe ₂ (SO ₄) ₃ Used.	Weight Iron Taken.	Remarks.
44	.0124	.0934	8.2238	Alone.
45	.0052	.0934	6.5678	+NaHCO ₃
46	.0048	.0934	6.5075	+K ₂ CO ₃
47	.0076	.0934	7.3948	+CaCO ₃

The action here, as when pure iron was used, has been more rapid. This was proved to be the case by

making two experiments and testing the amount of rust formed every hour for ten hours successively. In the tube heated to 110° the action was gradual; in the tube heated to 160° most of the rust was formed in the first hour. How long the action goes on, and at what rate it progresses, has not yet been determined. The next set of experiments was made with small pieces of steel, and here the action was the slowest.

No. of Expt.	Rust Formed.	Amount Fe ₂ (SO ₄) ₃ Used.	Weight of Steel Taken.	Remarks.
48	0064	0934	7.7526	Alone.
49	0062	0934	7.6843	Alone.
50	0020	0934	7.4232	+K ₂ CO ₃
51	0025	0934	7.3965	+K ₂ CO ₃
52	0081	0934	7.5742	+NaHCO ₃
53	0028	0934	7.4962	+NaHCO ₃
54	0048	0934	7.7922	+CaCO ₃
55	0042	0934	7.7800	+CaCO ₃

The above were heated to 110° C. in sealed tubes. The following were heated to 160° C. in sealed tubes:

No. of Expt.	Rust Formed.	Amount Fe ₂ (SO ₄) ₃ Used.	Weight of Steel Taken.	Remarks.
56	0072	0934	7.8423	Alone.
57	0030	0934	7.6364	+NaHCO ₃
58	0026	0934	7.7982	+K ₂ CO ₃
59	0041	0934	7.6541	+CaCO ₃

Potassium carbonate all through seems to be the best preventive, but its expense will, in most instances, preclude its use. Soda carbonate was tried in all kinds of proportion, but in no case was there complete arrest of the oxidation. The best amount of soda carbonate to use is 1½ grains for every grain of ferric sulphate found in the water. Further experiments in the retarding of rust formation are now in progress.

Kentucky State College.

—Amer. Chem. Jour.

SPECIFIC GRAVITY OF LIME WATER.

I HAVE recently had occasion to take the specific gravity of lime water, and have noted a peculiarity which appears to me to be of very great interest. According to a recent determination in my laboratory, a liter of lime water contains 1.344 grms. of CaO, and the specific gravity of the lime water reaches the extraordinary figure 1.0235, compared with distilled water at the same temperature reckoned as 1000.00 (the temperature was 13° C.)

It follows from these observations that in the formation of lime water a most extraordinary contraction takes place.

Before solution:

CaO.....	0.5 c.c.=	1.344 grms.
H ₂ O.....	1001.0 "	=1001.0 "

which contract so as to occupy one liter.

The contraction is, therefore, three times the volume of the lime which dissolves in the water and forms lime water.

The purity of the lime water was ascertained by exactly precipitating the lime by means of its equivalent of oxalic acid, filtering, and evaporating the filtrate to dryness; the residue was so small as to be insignificant.—J. Alfred Wanklyn, Chem. News.

ACTION OF ZINC CHLORIDE ON CASTOR OIL.

At a recent meeting of the Society of Chemical Industry, a paper by Dr. C. R. Alder Wright, F.R.S., was read on "The Action of Zinc Chloride upon Castor Oil," setting forth that the radical in castor oil is different from that of several other oily acids, in that it contains more oxygen. The glyceride of ricinoleic acid differs in various chemical and physical characters from the glycerides of the other common oils. The author and Dr. Muirhead found that zinc chloride in strong solution, or in the form of fused hydrated crystals, has a marked power of thickening and solidifying castor oil into a gristly mass, suitable for mixing with artificial colloidal insulating substances for electrical purposes, and that the kind of product can be regulated by varying the temperature and proportions of the mixture. The most effective treatment consists in evaporating down a solution of zinc chloride until its boiling point rises to nearly 175° C.; it is then allowed to cool to about 125° C., and is well intermixed by agitation with one third its weight of castor oil at about the same temperature. The oil is rapidly converted into a thick clot, and separates from the zinc chloride in lumps; it becomes a mass of cartilaginous nearly white shreds when deposited in water and agitated therewith. The zinc chloride is practically all recovered, and can be used over again. The shreds are practically insoluble in the various menstrua which dissolve castor oil; but the glyceride character is not destroyed.

INOSITE.*

THIS substance was first obtained by Scherer from muscular tissue, and has since been found to be a constituent of a large number of plants. The difficulty of obtaining it in any quantity has hitherto prevented its exact study. M. Maquenne has succeeded in obtaining a considerable quantity of it by extracting dried leaves of the walnut tree with water, and has subjected it to careful investigation. He finds that it has the composition represented by the formula C₆H₁₂O₆+2H₂O; and a determination of its molecular weight by the cryoscopic method of Raoult is also found to be in accord with this formula. It is optically inactive, and suffers no change when left in contact with *Penicillium glaucum*. Its molecule, hence, cannot contain an asymmetric carbon atom according to the rule of Le Bel and Van't Hoff. Inosite is not attacked by acids or dilute alkalis. It does not reduce Fehling's solution, nor does it act upon an ammoniacal silver solution. With acid sodium sulphite it does not unite, nor is it reduced by sodium amalgam. The halogens do not act upon it in the cold, but when it is heated with bromine to 100° C. it yields oxidation products similar to those obtained with nitric acid. Inosite is not an aldehyde nor an acetone, since it does not give, on oxidation, an acid containing six atoms of carbon, nor oxy-acids of the fatty series. Its molecule then cannot contain a lateral

* *Comptes Rendus*, 104, 4, 225.

chain, and it must therefore be a hexatomic alcohol derived from hexahydro-benzene—i. e., hexahydro-hexoxy-benzene, C₆H₆(OH)₆. The symmetry of this formula excludes, according to the theory of Le Bel and Van't Hoff, all rotary power. In another paper,* Maquenne shows that, by reduction with hydriodic acid, anhydrous inosite yields a small quantity of benzene and tri-iodophenol—a fact which lends strong support to the formula proposed by him. On oxidizing inosite with concentrated nitric acid, he obtained oxy-quinones, such as tetraoxy-quinone, rhodizonic acid, tri-quinone and croconic acid, all of which have been previously obtained by Nietzki and Benckiser from hexoxy-benzene, C₆(OH)₆. Hence inosite has the structure represented by the hexagonal symmetrical formula above given, since it yields, both on oxidation and reduction, derivatives of benzene.—W. R. O., Amer. Chem. Jour.

CARMINE SOLUTION.

MR. JOSEPH W. ENGLAND, in a paper read before the Pennsylvania Pharmaceutical Association on "Carmines as a Coloring Agent," gives the following formula for carmine solution:

Carmines (No. 40).....	4 drachms,
Water of ammonia.....	3 ounces.
Glycerin.....	3 ounces.
Water sufficient to make.....	8 ounces.

Rub the carmine into a fine powder in a Wedgwood mortar, make a paste with and dissolve in the water of ammonia, and then add, with constant trituration, the glycerin. Transfer to a porcelain capsule, and heat upon a water bath until the liquid is entirely destitute of ammoniacal odor, cool, and add the water. The entire removal of the ammonia gas requires the constant stirring of the liquid with a glass rod and rather lengthy heating.

The finished product is a permanent, deep ruby red liquid. It should develop no precipitate with mercuric chloride, indicating the absence of free ammonia gas, and on the addition of ammonium hydrate should acquire a purplish tinge.

This solution gives the true carmine color to solutions without exhibiting the purplish tinge so characteristic of alkaline solutions.—*Druggists' Circular*.

* *Comptes Rendus*, 104, 5, 297.

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