ANNALES

CHIMIE ET DE PHYSIQUE,

MM. ARAGO, CHEYREIIL , DUMAS , PELOUSE ,
BOUSSINGAULT, REGNAULT.

III the ils nruvi is czinl si ii riiisilu

Pae MM . WURTZ sr VER DET.

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pLSCE DR L'zCOA* DEIDE " , *' '7-

I àIYïiIMERIE DE BAGHELIER ,

(853.

the water vapor satu re or deprived of it alisolutely, by passing it through humid iubes or iubes filled with desiccants, rela tient ati friction cJufil tprouve against the surfaces to the coniaet of which it is exposed.

He concluded from his experiments that it is not by evaporating supersaturated saline solutions that air ends their crystallization, as Mr. Goskinski ct hf . Selmi.

hl. H. I.œwel adds new facts in support of this con-

i°. If, in a first tube, the air is naturalized with water v a p o r , and in a second t u b e , it is completely stripped of water vapor, the air has become adynamic;

z-. 11 did not become adynamic when heated by the heat developed in its desiccation by the caustic potash;

3º. Air becomes adynanic by passing through a tube of o'^ , it o'-, 5 de lonäueur stu o'-,o i5 à o'-,o i8 de diamètre , rempli de **coton**: expérience bien propre à démontrer que **c'est** par le frot - rement que l'a perd sa propriétc dynamique ;

4°. Whether this air arrives in the solution, rarefied or more dense than it is in the atmosphere, or equally dense, crystallization will not take place in these three cases.

xâxêiêa s¥R iÎ iTÎssê êa f1 ffxièêas

P-n Et. ARAOO (i).

The determination of the prodigious speed with which light travels through space is, without doubt, one of the most impressive results of modern astronomy. The ancients

(i) Just back f r o m Alrlque, in i8op, I æe deliveredrni still very young, **I was** vinpt-three years old, b **various ozperimente** relatireo h the in0uenee dii the ei- tos-o do the 1uniière on refraction. Le résultat de eion tr "i "ii r "i **'''n''** niqoê ù la première Claeee de l'Institut, le io décembre 1810. je résultat t quoique trés-different de celui auquel je êttls attendu, exeitn quelque in- ièrèt. M. Inplaee nde fait l'bonnetic de le ontlonner dana une der éditions de

bien aiiiel le citer dnnc 1s seconde £dttion de son *Traité fJ enterre d'Asti'o-nomie* pÀrsiçue. I thought from then on that)e could dicpenzer me to pobller my

Since that time, this traYaiÎ being rlesenu le polat de d6paet dee rn- chercher

Oxpérimentolos ot tliüoriquee qui ont ätö faites ou projetées dans di- York pays, sur l'ëttt dans loquel lequel se trouve l'èther dans lee corpa solides, j'ai believed this wisdom to be infinite; and their way of seeing it was not, on this point, as on so many other r}uestions of physics, a simple opinion ddiiuée dc preuves ¡because

Àristote , in supporting it, cites the instantaneous transmission of daylight. This opinion was en-

This idea was subsequently opposed by Alhaxen, in his "Fraité d'optique", but only by metaphysical reasoning, to which Porta, his commentator, who supported what he called the immateriality of light, also put forward some very poor arguments. Galileo appears to have b e e n the first of the moderns to determine this speed by experiment. In the first of the dialogues *delle Science*

Strove, he had *Salviati,* one of the three interlocutors, set out the very-iugenious čpreuves he had employed, and which he believed pro}'res to resolving the question. Two obser- x ateurs , with two luzuières , had been placed nearly a mile apart: one of them, at any given moment,

extinguished his light; the second covered his as soon as that he no longer saw the other; but, as the first obser-

vateur voyaítre la seeonde lumière au mème mo- ment où il cachait saienne, Galilée en conclut que la lu- mière se transmet dans un instant indivisible à une distance double de celle qui séparait les deux observateurs. Similar experiments carried out by members of the Aeadémie *net Cimenlo,* but for distances three times greater, led to the same result.

At first glance, these trials seem rather meagre, when one considers t h e magnitude o f their object ¡ but they are judged less harshly when one remembers

---

cłé iayitü, à diYoraee reprieœ, ă le pubÎier; æais łe btźœoire e'útan égarć, jo ne pouvait paß d$fćrer à ce ecu. 11 il y a peu do jourß qu'en rangant rues P-P'8-8 Pay Oï'd¢6 d6 Mgttè¢8 OD Ş' 8 t'GtŁottYé Î6 @úr0oir6 originul de t Ą t .

!-. '*-o -u!e* roppelé afore In déaie expriøıë p "r le- physicians, et j'ai demand'- ' c^démie la petmis8ion de faire paraltre mon Mćmoire dans le *Cozrzpie* i'en'źu, quoqu'il dat dat do qunrante-deux ans. I reproduce it here, oial malgré toutes ^'** impe8*ections , Bane cb8D§er un eou! znot.

that at about the same time, men such as Lord Bacon, whose merit is so widely appreciated, believed that the speed of light could, like that of sound, be significantly altered by the force and direction of the wind.

Descartes, whose system of light has so much in common with the system known as the *wave system,* believed that light is transmitted instantaneously at any distance, and supported this opinion with evidence drawn from the observation of lunar eclipses. It has to be admitted that this very ingenious line of reasoning proves, if not that the speed of light is infinite, at least that it is greater than any speed that could be determined by direct experimentation on Earth in the manner of Galileo.

The frequent eclipses of Jupiter's first satellite, whose discovery closely followed that of the telescope, provided Roëmer with the first demonstration of the successive motion of light. The still very imperfect knowledge of the motions of the other satellites, the difficulty of accurately determining their eelipses, and a number of unknown inequalities which, by combining with that which depended on the motion of light, masked its effects, made them less salient, and consequently prevented , Roümer's discovery was not generally accepted until Bradley had shown that this anti-nal motion, to which all stars are subject, and which we call *aberration,* depends on the combined effect of the motion of light and that of the observer. The speed iJu'on had deduced from this last phenomenon dilférait un peu Je celle qu'un obtcnait }'ar les éclipses du premier satellite ; mais la perl'ection à laquelle on a port'i les Tables, par les travaux de M. Laplace , a permis de revenir sur ces premiers "alruls , la constante dc l'aberration que M. Dclambre a trouvé par la discussion d'un très-grand nonibi e d'éclipses de satellites , est absolument la même celle que Bradley avait déduit de ses observations.

The first consequence to be drawn from this remarkable agreement is that light moves uniformly, or at least without any *perceptible* variation, throughout the space encompassed by the Earth's orb; the exceiitricity of Jupiter's orb allows us to extend this result to the vast inter-valley it embraces. As their absolute aberrations, according to direct observations, are more or less the same, Bradley concluded that the motion of light is uniform at all distances, and that the aberration of all celestial bodies can be calculated with the same constant. Some astronomers, however, had not adopted this result ¡ they suspected that stars of 'different sizes may emit rays at different speeds, and it must be admitted that this idea, especially in the

the emission, was both natural and probable. Direct observation of the aberration was hardly suitable for resolving this question decisively, since a difference in the speed of light, equal to ,-, of the total speed, should produce in the aberration only a difference of i", a precision which we cannot flatter ourselves to surpass, even with the aid of the best instruments; However, if we remember that the deviation experienced by light rays as they obliquely penetrate diaphanous bodies is a definite indication of their primitive speed, we will see that observation of the total deviation they are subjected to as they pass through a prism provides a natural measure of their speeds. This method is, moreover, very suitable for making slight i negalities sensitive; for, as is easy to demonstrate, a difference in x-itesses equal to produces a difference of s' in the deviations, even supposing that we only use a prism whose angle does not exceed 35'. This is also the course I followed in the experiments whose results I had the honor of reporting to the Class more than four years ago; light rays coming from various stars, the Sun, the Moon, the planets and terrestrial lunars, had undergone the same deviation ¡ the greatest discrepancies had amounted to 5", and this nomhre, which is the sum of the errors of observation and declination, corresponds moreover only to , of change in the vi- tessc and to seconds on t h e aberration ; I had concluded from these results that light moves with the same speed, whatever t h e bodies from which it emanates, or that at least, if there are any differences, they can in no way alter the accuracy of astrono- m i c a l observations.

Since the reading of my Memoir , M. Calendreli has published, in his Opuscules astronoiriiques, printed in Rome, some experiments made by this method, and which have led him to the same conclusions, except in what relates to sunlight, to which he assigns a particular refraction; but I was sure that this last result, whose accuracy cannot be accepted, was due to the fact that, when observing the stars, the Roman astronomer aimed at the center of the yellow light, whereas for the Sun, whose edge he was forced to observe, he pointed, on the contrary, at one of the extreme colors of the spectrum: i1 suÍfirait d'ailleurs, pour justifier, inddpen- damment de ces considórations, le rdsultat auquel j'utais parvenu, de remarquer que IU. Calendreli finds, as I do, that the Moon's spots, which we see only in reflected sunlight, are precisely the same as the Moon's spots, which we see only in reflected sunlight.
'lćviées de la mime quantity que les dtoiles.

We can see, moreover, that the certainty of the conclusions we draw with regard to lunar velocity, from observations made using dcs prisms, rests on cellc de la supposition qu'une inêgalitč de vitcsm produit une inégalité de déYia-

The experiments I have mentioned had given me a glimpse of the possibility of demonstrating this principle, but work on the meridian made me abandon this research, which I have been rethinking since my return, and the results of which I shall now communicate to the Class.

My experiments were just about complete, when reading one of the fine Memoirs that D* Young has inserted in the *Z 'i'ansactioits philosophiques ,* taught me that M. Rohisson , professor of physics at Edinburgh , had considered this question of the speed of light theoretically; I have since found, in various works, that it had been examined from different points of view by Bosco- wieh , Michell, Wilson and Blair.

Before turning to my own observations, I think I should mention the projects published by the above-mentioned physicists.

The idea of trying to a s c e r t a i n , by specific experiments, the increase in speed acquired by light rays as they pass from a rare medium into a dense one, must naturally have occurred to a great m a n y people; but Boscowich is, to my knowledge, the first to have published a reasoned experimental project in this respect. This physicist believed that when observing the stars through a telescope filled w i t h water, one should find, due to the increased speed of the rays as they penetrate this liquid, a different aberration from that observed when the space between the lens and the ocular is filled with air. This same circumstance was to bring about very noticeable changes in the position of terrestrial objects, which would thus have b e e n subject to diurnal aberration. He found, for example, that a sight located to the south, at the high solstice, would have described, in twenty-four hours, a circle of radius == 5", the center of which would correspond to the average position of the object;

but Boscowich's reasoning is flawed, in that he has forgotten to take account of refraction and, consequently, of the change in direction that rays must undergo as they penetrate obliquely from the glass into the liquid. Also Mr. Wilson, Professor of Astronomy at Glasgow, who published, in the *T'ransactions philoso-*

phiques pour l'année - 7 - , un Flémoire où il propose également la lunette remplie d' eau, comme un moyen de s'as-

In fact, he has proved that aberration in such a telescope will only be equal to that found with an ordinary instrument in cases where the velocities of the rays in the rare and diaphoretic media are in the ratio assigned by Newton. It should also be noted that the need to apply high magnifications to instruments designed to discover small quantities, rendered Boscowich's telescope useless, since the light o f a star would be, if not totally extinguished, at least considerably weakened, when it passed through a liquid thickness of 3 or 3 feet.

The difficulty presented by the v*fification of Newtonian theory arises from the principle which is a consequence of it, namely that the speed of light in any diaphanous medium must be the same, whatever the nature and number of media it has previously passed through. When refracting bodies are in motion, the refraction experienced by a ray must no longer be calculated with its absolute speed, but with the same speed, increased or decreased by that of the body, i.e. with the relative speed of the ra7on ¡ the movements of the body.

ments we can imprint on bodies on Earth,

too small to have any appreciable influence on the refraction of light, we must look to the much more rapid movements of the planets for circumstances to make these refraction inequalities more sensitive. Wilson, whom we have already quoted, had proposed using this method o f experimentation to investigate the translational motion of the solar system. D. Blair, to whom we owe a very interesting work on the dispersive force of liquids, believed that observation should render æ n s i b l e the inequality of velocity with which the light rays arriving at us from the two edges of Jupiter are reflected, due to the planet's rotational movement on itself; and M. Robisson, in a special Memoirs of Jupiter, proposed to use this method of experimentation to investigate the translational motion of the solar system. Robisson, in a particular Memoirs, where he examines in detail this question of the speed of light, also points to observations from the two edges of Saturn's ring.

Such were the means that these distinguished scientists had proposed to solve a problem that concerns both the progress of physics and astronomy ¡ it follows, moreover, from the historical outline we have just given, that they were rather6t concerned with tracing the route that had to be followed to arrive at a decisive result, than with undertaking observations whose great difiiculty they undoubtedly foresaw. I thought it would be important to use the means offered by the present state of our knowledge and the great precision of our instruments, to examine a question whose outcome seemed likely to provide some data on the true nature of light.

In my experiments, I have endeavoured to make the differences that must result from the Earth's translational moment visible, because our system's translational moment could, by combining with the Earth's, g i v e rise to fairly large inequalities. It's also natural to suppose that, just a s there a r e stars of different brightnesses in the sky, there are also stars of different sizes, and this circumstance, a s I believe the first one has shown, is the reason why the stars of our system are so different.

M. ãlicliell, must cause very noticeable speed differences i n the rays emanating from these various bodies;

This type of experiment also enabled me to observe with a short-focus telescope, whereas it would be essential to use high magnification to recognize the inequalities in planetary diameters. This method would also require the prisms to be very-perfect, since achromatic defects are a direct result of the magnification. A few tests I have already carried out, using III. Rochon's excellent prismatic mierometer, have given me hope of success; in the meantime, I'm going to inform the Class of the results of the first method, which, moreover, seems preferable in every respect.

When an object is viewed through a prism, the deviation inequalities can give rise to .changes in the speed of the light ra7 ns ,
must be all the more considerable as the angle of the
prism will itself be larger ¡ but, when using simple prisms or prisms made of a single substance, there is a limit that cannot be exceeded in this respect, because, for
As soon as the angle of the prism exceeds 4 or 5 degrees, the edges of the spectrum are diffused; and as the transition from one prismatic color to its neighbor is made by an insen-
The aehromatic prisms, whose angle can be increased at will, were much better suited to the object I had in view.

The one I used for my first experiments consisted of a crown-glass prism and a flint prism set against each other ¡ the difference between their angles, or the angle of the total prism, was roughly equal to s§ degrees.

In order to reduce, as much as possible, the partial reflections that light always experiences at the se- paration surface of media with very different densities, I had my two prisms roller-finished with the putty whose opticians use to attenuate polishing defects on the inner surfaces of lenses. The entire prism was immovably mounted in a box whose lateral trunnions could be rotated in callipers, giving the outer face the inclination that would produce the sharpest image. In order to be sure of observing in the plane of the rdfringent angle, a lateral movement was also me- naged, by a mechanism which would take too long to describe; it will zutfira me to say that the total apparatus could be fixed, by means of strong screws, to the ext6- rior cover of the mural's telescope.

fees choses étant ainsi disposées, j'ai mesuré dans la mème nuit, et à différentes époques , les distances au zénith d'un grand nombre d'étoiles; ces distances, comparées à celles qu'on aurait observé à travers l'air, donnent la quantité de la déviation que le prisme fait éprouver aux rayons lumineux; c'est ainsi qu'ont été formés les tableaux suivants :

Z.e 2B mace ¥CkO (mural).		**Le 27 mars 1810** (mural).	
Fugel. . ..	o i r io. j. sj , iG	"Orion	o.J.33, 8
ri d'Orion	CS ,5	Caetor..	a2 ,93
Ccsio r............	sg,6	Procyon ..	....
PrOCyOft . .-- . . - -.	Rj,9	3s ,3z	
Pollux.	z{j,3	Pollux / **β Lion**...............	3R, 26
e Hydre....	oe,6	a Hydre..........	28,8z
Regulus ....-. -	sS, z		38,
Virgin epl.	si,§	¥Cgrionvear	3z 3g
a. Crown...	ay ,8	**Antarès**........	28,19
e Serpent.	,3	**ξ Ophiuchus**......	29,64
Aninrès ... . - . - ..	sa ,5	y Virgin. .	22,80
ç Ophiuchus.......	p j ,o	8 Virgin.	sç,3§
		e Ylet-ge	ÀI , s
		i Lion...	3q,o-

I then glued together two achromatic prisms, similar to the one used for my first experiments; but, in order to make myself independent, in these new **tests,** of the knowledge of the declination of the stars, of the error of eollimation which can vary in our instruments, with the highúr of the telescope and the refraetion, I followed a dif- ferent method of observation.

The new prism I've just mentioned was fixed to the telescope by a repeating circle, so that half the objective was uncovered; by this arrangement, I could observe both through the air and through the prism: the difference between the two heights, corrected for the star's movement in the interval between the two observa- **tions**, gave me the deviation without the need to know exactly the absolute {'osition of the star ob- **served.** Moreover, by starting the observations a few minutes before the stars passed over the meridian, **I** was able to repeat them a sufficiently large number of times to attenuate both point and division errors at the same time; this is the method used to form the last table:

ou crm/r *m.Iiétitenr,* 8 *octubre* i 8 i o.

e de l'Aigle , deviation.....	m zn.z5.g
Moon spot.................................	mzaa.5.q
ri du Verseau......	m za. a5,z
ri Whale.	m az. a5.3
Aldebaran...	m a2. a5.o
Rigel	oo. s\. 59
"from Orion.............................	ma, 25. 2
Sirius.................	m az.a8

Now I had to **move on to** the consequences that flow from all these numbers.

First of all, we can see that inequalities in deviations are in

For this reason, they can be attributed to observational errors; but let's assume they are real, for a moment, and find out what speed inequalities they correspond to.

To do this, I take the analytical formula that expresses the deviation of light rays as a function of the angles of the prisms and their refracting forces; I dilute it with respect to the speed of light, which is determined by the ex- pression of the ratio of the sine of incidence to the sine of refrac- tion, and I thus obtain the variation of the deviation as a function of that of the speed. This calculation, which I

can only read the details , that , , ,~~, vari~~ation in the vi-

tesse de la lumière , devait produire , dans mon premier prisme , un changement de déviation égal à 6"; cette va- riation s'élève à près de i J" dans le prisme achrooiatique quadruple queyai appliqué à la lunette du cercle répétiteur: telles seraient donc les inégalités de déviations que je devrais trouver, si les rayons émis par les diverses étoiles que j'ai observé avaient des vitesses qui diïférassent entre elles de , , " . ~~The E~~arth's translational velocity is precisely equal to this number, and we know that its motion is directed towards the stars that pass at *6* o'clock in the morning and towards those that pass at 6 o'clock in the evening, in such a way that it approaches the former and moves away from the latter. The deviation, in the first case, must therefore correspond to the speed of emission increased by its , ,, part, and, in the second, to this same speed decreas~~ed by~~ , , ", i so that the rays of a star passing the meridian at 6 a.m. must be less strongly deviated than those of a star passing at 6 p.m., by an amount of

equal to that caused by ", a change in vi-

tesse iotale , i.e. i a" in the observations made at the mural, and s8" in those of the repeater circle.

The drift of the stars at midnight should be the average of these two.

A careful examination of the preceding tables shows that the radii of all the stars are subject to the same deviations, without the slight differences that we notice following any law.

At first glance, this result seems to be in clear contradi c t i o n with the Newtonian theory of refrac- tion, since a real inequality in the speed of rays nevertheless causes no inequality in the dtvia- tions they experience. It seems that this can only be explained by supposing that luminous bodies emit rays with all kinds of velocities, provided that we also admit that these rays are only visible when their velocities are within certain limits: in this hypothesis, in fact, the visibility of the rays will depend on their relative velocities, and, as these same velocities determine the quantity6 of refraction, the visible rays will always be equally rdfracted.

Although the preceding experiments are sulphurous in motivating the supposition I have just made, since without them t h e y could not be explained, it may not be useless to show that several other phenomena seem to make it equally necessary.

First of all, I'd like to point out that in assessing the differences to which speed inequalities must give rise, I've only taken into account the translational motion of the Earth, and that the translational motion of our system must, by combining with this first, be the source of new inequalities. Some stars, moreover, must be moving through space at very considerable speeds, since, despite their low parallax speeds, they are subject to very perceptible annual displacements; the speed of the rays they send us must therefore be the resultant of their primili Ye speed of emission, combined with that of the star.

However, one of the most powerful causes of changes in the speed of light seems to be the enormous size of the diameters of the stars.

It has been calculated that a star of the same density as the Sun, and whose diameter is a few hundred times greater than that of the Sun, would totally destroy the speed of its rays through its attraction, A star twenty times the size of the Sun, without completely destroying the speed of the rays it emits, would weaken it enough to create a big enough difference between their refraction and that of the Sun's rays; It would even suffice to suppose that the diameter of a celestial body was *once el* bernie greater than that of the Sun, for the speed of its light, at the distance separating us from it, to be diminished by its , , part, and consequently give rise to inequalities of deviation which, in the second of my prisms, would amount to i 5". Now, it seems unnatural to suppose that Sirius, I.yre, A rcturus and a few other stars that shine so brightly, despite their prodigious distance, are not equal to the Sun. In any case, we can see that unless we admit, as I did, that in **the infinite number of** rays of all speeds emanating from a luminous body, only those of a given speed are visible, we could only explain our experiments by excessively decreasing the density of the stars or their diameters; we would arrive, for example, at the singular result that in the infinite number of stars with which the celestial vault is studded, there is not a single one of the same density as the Earth, and whose volume is legal at the same time as that of the Sun.

11 ne sci'a prut-etre pas i nutile de nolrr que lrs oliser va-

d nit dr fihiiii' et de i'fi* z., 3- sëri o , i. XXX \' 11. (F*v rier i tIS3.' 1 .3

The observations I have just reported, and the assumption that explains them, are linked in a very remarkable way to the experiments of Herscliel, Wollaston and Ritter. The former found, as is well known, that outside the prismatic spectrum and on the red side, there are invisible rays, but which possess to a greater degree than luminous rays the property of echautfer ¡ the other two physicists recognized, at about the same time, that on the violet side there are invisible rays without heat, but whose chemical action on silver muriate and on several other metals is very similar to that of the light rays.

other substances is very sensitive. Don't these last ra7ons form the class of those which lack

to become visible, and wouldn't heat rays be those which too great a speed has already deprived of the property of illuminating? This supposition, however probable it may at first appear, is not rigorously established by some ezp4-riences, from which it can only be concluded that rays invisible due to excess and deJottt of speed respectively occupy the same place on the spectrum as *calorific* and *ehiou'fues* rays. *Moreover*, it is very remarkable that it should have been possible in this way, and through purely astronomical observations, to arrive at a knowledge of invisible rays outside the spectrum, the existence of which the famous physicists we have mentioned only recognized through delicate experiments using highly sensitive thermometers and substances whose color is altered by the action of light.

In the foregoing, I have not compared my experiments with the undulation system, because the explanation of refraction given in this system is based on a **simple** hypothesis that **is** very difficult to subject to calculation, and it was therefore impossible for me to determine precisely whether the speed of the rdfringent body should have any influence on refraction, and if so, what changes it should bring about.

I have only attempted to show that by assuming that light rays are only visible when their velocities are within certain limits, my experiments can be perfectly reconciled with Newtonian theory. But if, as is probable, the limits which determine the visibilty of the rays are the same for different individuals, the unequal density of the vitreous humours must cause the rajrons to be seen unequally fast ¡ the result would be that two people looking at the same star, in the same prism and under similar circumstances, could see it deviate unequally. The result of this experiment, whatever it may be, should provide some data on the kind of sensation that makes us perceive objects. It seemed to me that the only way to make these tests decisive was to use crossed prisms, as observations can then be made with great precision, whatever the size of the refractive angle. I shall therefore wait to report to the Class on the experiments I have carried out in this respect, until time has allowed me to add the results of this method to those I have already obtained using achromatic prisms; for the time being, I shall confine myself to pointing out that I can draw several rather important astronomical conclusions from the foregoing.

We see: i°. That the aberrations of all celestial bodies tions, whether they send us their own light or reflected light, must be calculated with the same con- stant, without there being, in this respect, the slightest di$erenee, as I had deduced from my first experiments;

s°. That the phenomena that have been explained by an inequality in the speed of light, such as the appearance of the stars on the **Moon**'s disk a few seconds before the moment of immersion, the displacements in the small stars that are very close to the large ones, etc., cannot depend on this cause, S°. that the hypothesis with which Piazzi sought to explain the differences found between the obliquity of the ecliptic deduced from observations made at the two solstices, is totally contrary to experiments, since it amounts to supposing that sunlight does not refract like starlight;

d*. In other words, the refractive power of the air we
Biot and I deduced from the observation of a terrestrial object, must be absolutely equal to that which we would have found if, in our experiments, it had been possible to aim at a star. It was all the more important to dispel any doubts that might have arisen in this respect, as this refractive power is, as we know, the main element in the Table of Refractions.

ACIDE CAMPHOMÉTHYLIQUE;

PxR ÀI, A. LOIR.

In order to obtain camplionietliylic acid, the existence of which was not yet known, I followed the procedure indicated by II. Malaguti for the preparation of camphovinic acid, substituting only inethyl alcohol for alcohol

This acid appears either in the form of centimetre-long needles radiating from a center, or in the form of small liexagonal or quadrilateral blades. When dissolved in ether, it slowly evaporates to form very small, fairly large, isolated crystals, shaped like a right prism with a rhombic base; the lateral faces forming the acute angle are nicely shaped, and each apex is modified by a facet. The quadrilateral blades deposited by rapid evaporation of the etheric solution are unc mo- diíicatiou licmiüilriqiu-. At each extremity, drux den fa-