

When the chain starts to slide toward A

$$px \sin V - cp \times \cos V = p(1-x)$$

$$\text{and } x = 1/(\sin v + 1 - c \cos v)$$

When the chain starts to slide toward C

$$px \sin V = p(1-x) - cpx \cos V$$

$$\text{and } x = 1/(\sin v + 1 + c \cos v)$$

Hence, the maximum length is  $1/(1 + \sin V - c \cos V)$

And the minimum length is  $1/(1 + \sin V + c \cos V)$

*From the same examination. No. 3.*

An organ pipe gives a certain tone at  $0^\circ$ . How much must the temperature rise to raise the pitch one-half tone?

The speed of sound in air is proportional to the square root of the absolute temperature of the air. One-half tone is an interval of 16/15. Absolute zero is at  $-273^\circ \text{C}$ . Temperature expansion of the pipe is not to be considered.

*Solution by Mr. Lundberg.*

Call the temperature  $t^\circ$  (Celsius!)

$n_t$  and  $n_o$  are the two vibration numbers at  $t^\circ$  and  $0^\circ$ .

$h_t$  and  $h_o$  are the speeds of sound at  $t^\circ$  and  $0^\circ$ .

Then  $n_t = h_t/\lambda$ , and  $n_o = h_o/\lambda$ ; therefore  $n_t/n_o = h_t/h_o$

but  $n_t/n_o = 16/15$ ; therefore  $h_t/h_o = 16/15$

but, if  $T = 273 + t$  Then  $h_t/h_o = \sqrt{T/273}$

Hence,  $16/15 = \sqrt{T/273}$  and  $T = 256/225 \cdot 273 = 310.6$

and  $t = T - 273 = 37.6^\circ$ .

Therefore the temperature is  $37.6^\circ$ .

386. *From the same examination.*

A glass ball, whose cubical coefficient of expansion is .000024, weighs in air 90 gm. If it is put into a certain liquid the temperature of which is  $12^\circ$ , it weighs then 49.6 gm. If the liquid is heated to  $97^\circ$ , the weight of the glass ball will be 51.9 gm. What is the coefficient of expansion of the liquid?

*Solution by Mr. John Lundberg.*

The volume of the ball is  $v_1$ , and  $v_2$  at  $12^\circ$  and  $97^\circ$ .

The specific gravity of the liquid is  $s_1$  and  $s_2$  at  $12^\circ$  and  $97^\circ$ .

Call the expansion coefficient for the liquid  $x$  and for the glass  $g$ .

$$\text{Then } v_{1s_1} = 90 - 49.6 = 40.4$$

$$v_{2s_2} = 90 - 51.9 = 38.1$$

$$\text{but } v_{2s_2} = v_o s_o (1 + 97g) / 1 + 97x$$

$$\text{and } v_{1s_1} = v_o s_o (1 + 12g) / 1 + 12x$$

$$\text{Hence, } 1 + 97g / 1 + 12g \cdot 1 + 12x / 1 + 97x = 38.1 / 40.4$$

$$1 + 97x / 1 + 12x = 40.4 / 38.1 = 1.002328 / 1.000288 = 1.0625$$

$$\text{Therefore } x = 0.0007418$$

Answer: The coefficient of expansion for the liquid is 0.0007418.

## PHYSICS IN SWEDEN.

BY JOHN LUNDBERG,

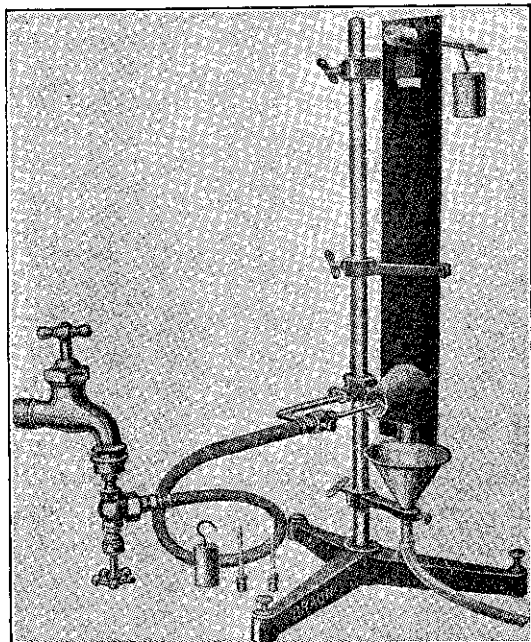
*Högskola-läroverket, Göteborg, Sweden*

[The following is an extract from a letter to Franklin T. Jones, Editor of the Science Questions Department. It contains information which will prove very interesting to all students of the science situation in American schools. F. T. J.]

Perhaps it may interest you to hear something about the organization of the teaching of physics at our state schools. The boy (or girl) enters this sort of school at 9-10 years of age. Physics begins with the fourth year with 2 "hours" per week (the "hour" being always 45 minutes) plus 1 laboratory of two hours every other week (the school year = 39 weeks), the course being statics and heat. In the fifth year there is only 1 hour per week plus 1 laboratory of two hours every other week. The course is magnetism and electricity.

With the beginning of the sixth year, the pupil enters the "gym-

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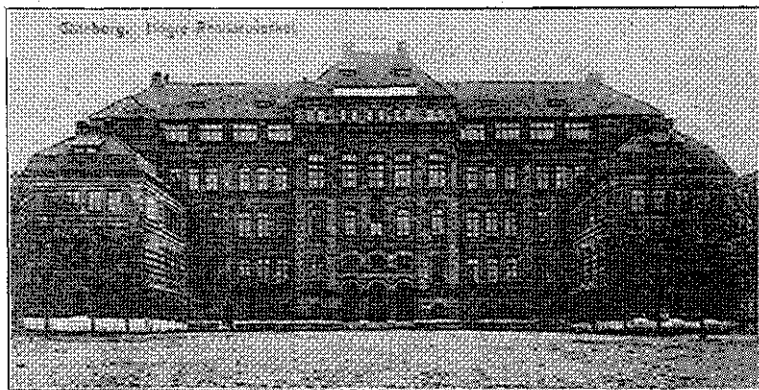
nasium" the forms of which are called "first ring", "second ring" etc. In the Latin-gymnasium they are taught Latin and Greek, but less mathematics and physics and no chemistry. In the Real-gymnasium there is no Latin or Greek but more importance is attached to mathematics, physics and chemistry. The physics courses of this real gymnasium are as follows:

Ring 1. (3 hours per week) *Statics* (wider course than in the 4th year) The most important laws of dynamics, a little astronomy.

Ring 2. (2 hours per week plus 1 laboratory of 2 hours every month.) Heat, magnetism, electrostatics.

Ring 3. (4 hours per week plus 1 laboratory of 2 hours every month.) Electrodynamics, Acoustics, Optics (partly).

Ring 4. (3 hours per week plus 1 laboratory of 2 hours every month during the fall terms.) The rest of optics dynamics, repetition of the whole gymnasium curriculum.



HIGHER REAL SCHOOL, GÖTEBORG

The *student examination* consists of written and oral tests. On the real gymnasium there are written tests in Swedish, Mathematics, English, German and physics. Each test has its day, hence physics is "5th day of writing," there being always one day free between every two days of writing. These tests are in the middle of April. About one month to six weeks later come the oral tests in all the disciplines which are taught in the 4th ring, there being specially elected university professors (called "censors") going from school to school in groups of three and determining for every discipline on what chapter the teacher must examine, this order being given just immediately before the examination in which that discipline is to take place, so that neither teacher nor pupils can know anything about it before. So you see there is a little excitement in it. The Censors attend to the examination, and afterwards they decide if a pupil is to be approbated or not.

At most state schools there are both Latin and real gymnasia. But in Stockholm and Göteborg the two greatest cities, there are schools with one line only. So here in Göteborg we have one school of each sort, the *Högre-Lätinläroverket* with about 800 pupils and the *Högre Real-läroverket* with about 700 pupils. Besides these "higher schools" with gymnasium (these are all for boys only) there are in many places schools with only six forms, leading to a lower examination, the "real-skolexamen." The sixth form in those schools has its own curriculum, which is not the same as in the first ring. Here in Göteborg are two schools of this sort, each with about 500 pupils. For the matriculation at a university you must have passed the "studentexamen" and this examination is in the common mind considered a sign of higher education, those having passed it belonging thereby to the higher social layer. So the white velvet cap, that marks the "student" is highly strived for and there is much poetry about it.