and that the inconstancy of the demonstration of the inhibiting factor may be a consequence of its extreme lability or poor extraction.

TABLE 1

EFFECT OF "DIABETOGENIC" PITUITARY AND SPLENIC EXTRACTS ON RAT MUSCLE HEXOKINASE ACTIVITY*

Expt.	Effect of pituitary	CO_2 produced (mm.^{3})	Expt.	Effect of spleen	CO_2 produced (mm.^{3})
1	Extract alone	53	3	Extract alone	54
	Extract + APE	8		Extract + 0.4 ml. spleen	35
	Extract + APE + insulin	56		Extract + 0.4 ml. spleen + insulin	57
2	Extract alone	48		Extract + 0.2 ml. spleen	46
	Extract + APE	50		Extract + 0.2 ml. spleen + insulin	53
	Extract + APE + insulin	50		Extract + 0.1 ml. spleen	49
				Extract + 0.1 ml. spleen + insulin	53

* The hexokinase activity of the muscle extracts was measured manometrically. The APE was prepared according to Young (*3*). The splenic extracts consisted of 1 part spleen + 4 vols. water homogenized in a Waring blendor, adjusted to pH 4, filtered, and the filtrate adjusted to pH 7.5. Insulin was added to a final concentration of 400 γ/ml. Figures give gas production for a 45-minute period of incubation.

Since the results of Price, *et al.* were obtained with fractions of pituitary quite different from those used in the above experiments, our data are not to be construed as a lack of confirmation of their results. They do indicate, however, that a tissue fraction quite distinct from the "diabetogenic" hormone may be responsible for the inhibition of hexokinase activity. That the presence of factors responsible for hexokinase inhibition may not be uniquely confined to the pituitary has been suggested by our observations (Table 1) that splenic extracts actively inhibit hexokinase and that the degree of inhibition

TABLE 2

EFFECT OF INSULIN ON HEXOKINASE EXTRACTS FROM MUSCLES OF ALLOXANIZED AND NORMAL RATS*

Type of extract	CO_2 produced (mm.^{3})	Micrograms phosphorus/ml. reaction mixture			
		Before incubation		After incubation	
		P_0	P_7	P_0	P_7
"Alloxanized" extract alone	60	112	161	109	123
Extract + insulin	59	112	158	111	124
"Normal" extract alone	43	87	147	92	118
Extract + insulin	39	87	147	93	117

* Muscle extracts were prepared and their hexokinase activity measured manometrically and chemically. The blood sugar of the alloxanized rat was 415 mg. per cent. Results were obtained after a 45-minute incubation. Insulin was added to a final concentration of 400 γ/ml .

is proportional to the amount of splenic extract added. In contrast to the experience of Price, *et al.* with anterior pituitary extracts, the amount of inhibition produced by splenic extracts has been relatively small, due perhaps to their lack of concentration. Whereas splenic extracts almost invariably produce significant inhibition, by manometric criteria, the degree of reversal of this inhibition *in vitro* by added insulin has been most inconstant, varying from no increase in activity to complete restoration. The significance of these observations and the nature of the inhibiting factor are being investigated.

In view of the preceding, we found it pertinent to test the postulate that there is a decrease in the activity of the hexokinase preparations obtained from the muscles and liver of alloxanized rats and that the addition of insulin *in vitro* will cause an increase in the range of normal activities. Rats were rendered diabetic by the administration of alloxan, and extracts of muscles from such rats were prepared as above and used immediately. In all instances, such extracts displayed an hexokinase activity comparable with that found in extracts of normal rat muscles. Further, the addition of insulin failed to increase the activity of either "normal" or "diabetic" extracts (Table 2).

Since our alloxanized rats exhibited a marked hyperglycemia and glycosuria, while the extracts from such rats gave no evidence of a depression of hexokinase activity, it would appear that the disorders of glucose metabolism encountered in diabetes do not necessarily result from any inhibition of hexokinase activity.

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Antares (α Scorpii)

OTTO STRUVE

The W. J. McDonald Observatory, Fort Davis, Texas

The night of July 2–3 was exceptionally fine at the McDonald Observatory, on Mount Locke, in western Texas. The sky was perfectly clear, and the apparent "tremor-discs" of the stars, as seen in the 82-inch reflecting telescope were unusually small. These conditions made it possible for me to carry out an experiment which I had sta ted in the summer of 1940 (*1*), but for the completion of which conditions—atmospheric as well as instrumental—were never sufficiently favorable during the intervening years.

Antares (α Scorpii) is a visual double star, consisting of a first-magnitude, red supergiant and a sixth-magnitude, blue, underluminous helium sta The separation between the two stellar components is 3″ (seconds of arc). Ten years ago O. C. Wilson and R. F. Sanford (*2*) found, at the Mount Wilson Observatory, that the spectrum of the faint blue companion of Antares contains emission lines which correspond to low-level forbidden transitions of ionized iron, [Fe II]. These lines were first identified by Merrill in the spectrum of η Carinae, soon after the solution of the problem of the nebular forbidden radiations by Bowen.

The purpose of my work at the McDonald Observatory was to find the source of the forbidden iron lines in the spectrum of the companion of Antares Good "seeing" conditions were required in order to separate the light of the very luminous red star from that of the faint blue star. I at first turned the large stellar slit-spectrograph (attached below the

Cassegrain focus of the 82-inch telescope) until the slit was at right angles to the line joining the two stars. An exposure of 26 minutes, during which the faint star was kept trailing along 2 mm. of slit length, produced the usual widened spectrum of the helium star, with the lines of [Fe II] in emission superposed over the continuous spectrum. Next, an exposure of 5 minutes, with the star held stationary on the same place upon the slit produced a heavily overexposed continuous spectrum of the star, 0.18 mm. in width, which corresponds to 2.6″ (seconds of arc). This width is due partly to the tremor-disc of the star and partly to photographic overexposure. The forbidden iron lines, expecially λ4287.41, extend on both sides of the star's continuous spectrum, like two little black arrows, to a distance of 0.074 mm., or 1.1″. The appearance of these arrow-like extensions is very much like that of the hydrogen lines in W. W. Campbell's famous "hydrogen-envelope star," and the explanation of the phenomenon is doubtless the same: the [Fe II] emission lines originate in a small nebulosity surrounding the blue companion of Antares.

But before we can be entirely certain we must convince ourselves that the extensions of the emission lines are not a photographic effect. Perhaps the star image was not as tranquil on the slit as I thought, so that underexposed edges on both sides of the heavily exposed strip might leave the continuous star spectrum invisible, though the bright lines would show upon development. To test this I obtained, under similar conditions, with the star-image fixed upon the slit, exposures of 5, 15, and 45 seconds. If the "spilled-over-the-edge" star light had caused the emission lines on the 5-minute exposure, then these short exposures should give the emission lines an opportunity for appearing in the central strip, where the continuous spectrum had appeared on the longer exposure. In reality, the 5-second exposure shows only the barest trace of continuous spectrum; the 45-second exposure shows it plainly. But not one of the three shows even a trace of the [Fe II] lines. The light of the helium star itself does not contain forbidden iron. The emission lines come only from a small nebulosity, about 5″ (seconds of arc) in diameter, which surrounds the helium star.

Next, I turned the spectrograph until the slit was along the line joining the two stars. With two exposures, of 1 and 3 minutes, I could separate completely the two star spectra. The [Fe II] lines again appear as faint extensions on both sides of the helium star. They are not strengthened in the space between the two stars, and, if anything, they suggest that the nebulosity may be slightly elongated in a direction at right angles to the line joining the two stars.

The nebulosity is enormously large in linear measure. The bright red primary star is one of the few whose diameters have been measured by Pease with the Mount Wilson interferometer. It is 0″.040, or 450 times the diameter of the sun. The nebulosity is about 150 times larger, which would make it 50,000 times larger than the sun. The diameter of the helium star has not been measured, but it can be inferred from the temperature and distance to be roughly one or two times the diameter of the sun. Near the outer boundary of the nebulosity the density of the helium star's radiation is weakened by a factor of the order of 10^{-9}, as compared to the density of radiation within its atmosphere proper. Very roughly, we may say that the nebulosity is about 10 times larger, in diameter, than the solar system.

Despite the fact that from a representative point within the nebula the red star appears as a disc which is about 200 times larger than the blue star, it is the light of the latter—in the ultraviolet region—which is responsible for the ionization of the gases, though not necessarily for the excitation to low-lying atomic levels.

A very strange result of observation is the absence of any other emission lines than [Fe II]. That the permitted Fe II lines are not photographed was explained some years ago by Swings and me as a consequence of what may be described as a fictitiously low excitation temperature. But why are the lines of hydrogen absent? Normally, we observe them with great strength in nebulae, in the interstellar gas, and in almost all star spectra. If they are absent in the nebulosity of Antares, we immediately try to infer that there is too little ionization for recombinations to take place. But since we observe no Fe I (or any other atoms of low ionization potential) in the nebula, we must have a majority of the iron atoms once ionized. The potential is 7.8 volts. Then, if we apply this to hydrogen, with 13.5 volts, we find that approximately 1 out of 10 hydrogen atoms is ionized and therefore capable of producing an emission spectrum by recombination. The usual cosmical abundance of hydrogen is perhaps 10^4 times greater than that of iron. Hence, there would be all reason to expect the Balmer lines to appear strong in emission (as, in fact, they do in ordinary gaseous nebulae).

It seems to me that the absence of H suggests a real—not only an apparent—paucity of hydrogen in the nebula of Antares. How can we explain this?[1] An attractive idea is to suppose that the nebulosity[2] is not strictly gaseous but that it consists of solid, perhaps even meteoric, particles which have long ago lost most of their hydrogen and are rich in iron. We certainly have such a nebulosity in the solar system, where it leads to the phenomenon of the solar corona on one side and to that of the zodiacal light on the other. We observe emission lines in the corona, but not in the zodiacal light. But that may be due to the relative weakness of the solar radiation in ultraviolet wave lengths. What I am suggesting here is that the [Fe II] radiations in Antares are, in a sense, a counterpart to what in the solar system we know as comet radiations. This hypothesis would explain not only the absence of H but also the very strange dependence upon excitation potential[3] which Swings and I observed in the intensities of permitted Fe II in other, similar objects (WY Geminorum, Boss 1985, etc.).

References

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[1] We might think of the atmosphere of the earth, which is also poor in H, but which shows, in the spectrum of the night sky, strong forbidden lines of oxygen, [O I]. Since these lines are absent in Antares, as are also the lines of [O II], we must look for a source which is not only depleted in hydrogen (as is the atmosphere of the earth) but also in oxygen and nitrogen—that is, in all light elements.

[2] Astronomers will recall that in 1936 we found a large reddish nebulosity around Antares which shines by reflected light from the red supergiant. This reflection nebula (*Astrophys. J.*, 1936, 84, 219) is vastly larger than the nebula considered here. There may be no connection between the two, although the large reflection nebula also consists of solid interstellar particles.

[3] An interesting and perhaps significant feature is the great strength, on my recent spectrograms, of [Fe II] 4287, as compared with [Fe II] 4244. They belong to different multiplets.