$C_{26}H_{45}O_6N_3$: C 63.24; H 8.78; N 8.52.) is identical in thin layer and analytical paper chromatography [1] with DNP-C_{20}-dihydrosphingosine, obtained from C_{20}-sphingosine through catalytic hydrogenation. Its infrared spectrum is identical with that of DNP-C_{18}-dihydrosphingosine. After oxidation with potassium permanganate octadecanoic acid is the longest acid identified. Under the same conditions DNP-C_{18}-sphingosine yields tetradecanoic acid while DNP-C_{18}-dihydrosphingosine and DNP-C_{20}-sphingosine yield hexadecanoic acid.

The new sphingosine has been isolated from human and bovine brain and from hair. In human brain it is found only in gangliosides. Cerebrosides, sulfatides and sphingomyelins contain C_{18}-sphingosine and a few per cent of C_{18}-dihydrosphingosine but no C_{20}-sphingosines. The total ganglioside fraction is composed of about one third of C_{18}-sphingosines and two thirds of C_{20}-sphingosines. Of these the proportion of saturated to unsaturated sphingosines is about 1 to 10.

Recently, a small amount of stearic acid was reported as an oxidation product from a mixture of ganglioside long chain bases.[7] This is probably derived from the sphingosine here described.

Details of this work will be published later. Different natural and synthetic substances used as references during this work were kindly supplied by Herbert E. Carter, University of Illinois, Paul W. O'Connell, The Upjohn Company, Michigan, and David Shapiro, Rehovoth, Israel.

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Some New 1,2,3,4-Thiatriazoles

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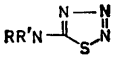
In connexion with some investigations on the thiosemicarbazides (Studies of Thioacids IX, *To be published*) we have prepared several new 1,2,3,4-thiatriazoles. The thiatriazoles listed in Table 1 were prepared from thiosemicarbazides and nitrous acid by the usual procedure.[1] The main reason for preparing these compounds was to complete the series, the methyl, ethyl, butyl, benzyl and phenyl derivatives being known.[1] The ethoxycarbonylmethyl derivative (N-(1,2,3,4-thiatriazol-5-yl)glycine ethylester) was prepared as an example of a 1,2,3,4-thiatriazole with a functional group. This compound was, however, rather unstable and decomposed on attempts to transform it into the free acid or the amide.

5-Acylamino-1,2,3,4-thiatriazoles could not be prepared by acylation of 5-amino-1,2,3,4-thiatriazole, since fission of the thiatriazole ring took place. Acylisothiocyanates were found to react with hydrazoic acid to form 5-acylamino-1,2,3,4-thiatriazoles, but difficulties were encountered when purifying these compounds. These reactions are now being studied in more detail.

Furthermore, some 5-*o*-alkoxyphenyl-1,2,3,4-thiatriazoles (Table 2) have been prepared from the corresponding dithioates and sodium azide. These reactions were studied because it was known from other experiences that an *o*-alkoxy group with secondary or large alkyl groups could exert a steric hindrance.[2] However, all the compounds investigated reacted in the normal way.

None of the compounds described here exhibited the azide band near 2200 cm^{-1} in their infrared spectra and are therefore true thiatriazoles and not thioazides.

All thiatriazoles listed in Table 2 show a medium strong infrared band near 1575 cm^{-1}. Infrared spectra were further recorded for 8 of the 13 thiatriazoles described in our earlier paper [3] (with the substituent in 5-position = phenyl, *o*-tolyl, *m*-chlorophenyl, *o*-methoxyphenyl, *p*-hy-

Table 1. Substituted 5-amino 1,2,3,4-thiatriazoles, RR'N– 

R	R′	Formula	Yield %	M.p., °C	Analyses						Characteristic IR-bands (all vs), cm^{-1}
					Found			Calc.			
					C	H	N	C	H	N	
Propyl [a]	H	$C_4H_8N_4S$	76	58–59	33.16	5.48		33.33	5.59		1560
Isopropyl [a]	H	$C_4H_8N_4S$	83	62–63	33.23	5.54		33.33	5.59		1575
Isobutyl	H	$C_5H_{10}N_4S$	80	27–31	38.02	6.28		37.97	6.37		1555
sec-Butyl	H	$C_5H_{10}N_4S$	70	27–29	37.85	6.41		37.97	6.37		1550
tert-Butyl [a]	H	$C_5H_{10}N_4S$	95	113–14	37.83	6.52		37.97	6.37		1560
Ethoxycarbonylmethyl [b]	H	$C_5H_8N_4O_2S$	65	69–69.5	32.22	4.50	28.98	31.91	4.25	29.79	1550
Cyclohexyl [c]	H	$C_7H_{12}N_4S$	85	108–09	45.05	6.77	30.33	45.64	6.57	30.42	1560
β-Phenethyl [d]	H	$C_9H_{10}N_4S$	92	90–91	52.25	4.70		52.42	4.89		1575
Diphenylmethyl [e]	H	$C_{14}H_{12}N_4S$	80	132–33	62.37	4.60	21.04	62.68	4.51	20.89	1545
Triphenylmethyl [f]	H	$C_{20}H_{16}N_4S$	75	167–68	69.55	4.93	16.37	69.75	4.68	16.27	1505
Phenyl [e]	Phenyl	$C_{13}H_{10}N_4S$	94	146.5–47	61.55	3.98		61.44	3.96		1482

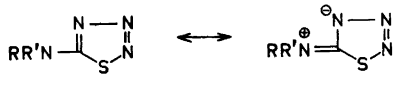
Solvents used for recrystallisation:
a) hexane; *b*) heptane; *c*) ethanol-water; *d*) methanol-water; *e*) ethanol; *f*) ethanol-light petroleum (b.p. 100–180°C).

Table 2. 5-*o*-Alkoxyphenyl-1,2,3,4-thiatriazoles, *o*-RO-C_6H_4-CN_3S.

R	Formula	M.p., °C	Analyses					
			Found			Calc.		
			C	H	N	C	H	N
Ethyl	$C_9H_9N_3OS$	104–05			19.66			20.28
Isopropyl	$C_{10}H_{11}N_3OS$	114–15			19.04			19.00
Butyl	$C_{11}H_{13}N_3OS$	115–16	56.05	5.55	17.89	56.16	5.57	17.86
Isobutyl	$C_{11}H_{13}N_3OS$	74–75			17.64			17.86

droxyphenyl, *p*-methoxyphenyl, 2-naphthyl and 2-thienyl), and in all cases the same band was found at 1570–1580 cm^{-1}. This band must not be confused with the phenyl bands which are found near 1600 and 1500 cm^{-1} in most of the compounds, or with the thienyl band at 1530 cm^{-1} in the spectrum of the 5-(2-thienyl) derivative. We assign this band to the interaction between the C=N, N=N, C–S and N–S stretching vibrations of the heteroaromatic thiatriazole ring. Lieber *et al.*[4] have found the same band in all the thiatriazoles which they have investigated. These authors have further assigned various infrared bands between 880 cm^{-1} and 1120 cm^{-1} to the skeletal vibrations of the thiatriazole ring, and a band at 1270–1300 cm^{-1} to the cyclic =N–N=N– grouping. While it is true that such bands are found in the spectra of most thiatriazoles, the spectra are so complicated in these regions that we feel that such assignments can not be made with any certainty for the 5-aryl-1,2,3,4-thiatriazoles.

Similarly all the substituted 5-amino-1,2,3,4-thiatriazoles have a band in the 1540–1590 cm^{-1} range (see Table 1) but it is very much stronger, and in most cases is the strongest band of the spectrum. The increased intensity of this band in comparison with the corresponding band in the spectra of the thiatriazoles substituted with C-radicals is presumably due to the resonance structure:



so that this band is mainly due to C=N stretching, coupled to a certain extent with an N–H deformation mode, when R′ = H (see below).

This band is very similar to the strong and rather broad band in the same region of the spectra for most thioamides which also have the character of a C=N stretching vibration.[5]

In the infrared spectrum of 5-amino-1,2,3,4-thiatriazole this band is found at a somewhat lower frequency (1521 cm^{-1}), but the spectrum of this compound shows another strong band at 1625 cm^{-1} due to NH_2 deformation. This is confirmed by deuteration, in which the 1625 cm^{-1} band is weakened considerably, whereas the 1521 cm^{-1} band is left almost unchanged. Kuhn and Mecke [6] in a study of the infrared spectrum of 5-amino-1,2,3,4-thiatriazole refrained from deuteration studies because they thought that this compound is decomposed by treatment with heavy water. However, this is only the case when the solution is boiled or kept at elevated temperature. When this compound is dissolved in heavy water at a temperature not exceeding 50°C and the solution evaporated *in vacuo*, there is no decomposition at all. On treatment of the deuterated product with water, the original infrared spectrum could be reproduced completely unchanged.

On deuteration of the 5-alkylamino-1,2,3,4-thiatriazoles the strong band in the 1500–1600 cm^{-1} range was also left essentially unchanged. However, it is somewhat weakened and a new band appears at 20–30 cm^{-1} lower in frequency. These results show that both the N–H deformation and C=N stretching contribute to this band.

The only bands in the infrared spectrum of 5-amino-1,2,3,4-thiatriazole which are wholly unchanged on deuteration are the two bands at 945 cm^{-1} (m) and 1115 cm^{-1} (s), respectively. These bands must therefore be due to the thiatriazole ring. Similar bands, unchanged on deuteration, are found in the infrared spectra of all compounds listed in Table 1, at 930—960 cm^{-1} (w—m) and 1060—1115 cm^{-1} (m—s). Although these spectra also exhibit other bands — due to the hydrocarbon radicals — which are unchanged on deuteration, the constancy of the above mentioned bands makes it plausible that they are due to the thiatriazole ring. However, there seems to be no basis for the assignment of a band at 1270—1300 cm^{-1} to the thiatriazole ring.

Experimental. The substituted 5-amino-1,2,3,4-thiatriazoles were mainly prepared according to the methode given in *Inorganic Syntheses*.[1] A typical example is the preparation of 5-propylamino-1,2,3,4-thiatriazole: To an ice-cooled solution of 4-propylthiosemicarbazide (4 g; 0.03 mole) in 2 N hydrochloric acid (15 ml) was added slowly with stirring a solution of sodium nitrite (2.07 g; 0.03 mole) in water (15 ml). The thiatriazole separated out as an oil which crystallised on scratching. The crystals were filtered, washed with icecold water and recrystallised from hexane. Yield and m.p. see Table 1.

The isobutyl and *sec*-butyl derivatives repeatedly separated out as oils from pentane and hexane and could not be recrystallised; therefore their melting points are not so sharp. 4-*tert*-Butylthiosemicarbazide and the phenyl-substituted thiosemicarbazides are almost insoluble in 2 N hydrochloric acid, but this did not affect the reaction if stirring was continued for ½ h after the addition of the nitrite. However, in the preparation of the benzhydryl and trityl derivatives, the thiosemicarbazide was dissolved in glacial acetic acid. In the preparation of the N-thiatriazolylglycine ester, the solution was cooled to −10°C and the thiatriazole extracted with ether as soon as the solution became yellow on addition of the nitrite solution. The compounds with aliphatic substituents deflagrate on heating at 115—120°C with the formation of sulfur, whilst the phenyl and cyclohexyl derivatives decompose with gas evolution at their melting points. Even at room temperature the thiatriazoles decompose slowly, as is shown by the establishment of an excess pressure in the storage bottle when they are kept tightly stoppered.

We tried to prepare 5-acylamino-1,2,3,4-thiatriazoles by the reaction of acetylisothiocyanate, benzoylisothiocyanate or ethoxycarbonylisothiocyanate with hydrazoic acid (dissolved in ether). The solution on standing for 1—2 days at room temperature gave a solid product. The yield of this amounted to 60—70 % of that calculated, but most of it was insoluble in all the common solvents. From the reaction of acetylisothiocyanate we did not succeed in isolating a well defined product, but for the other two cases, extraction of the crude products with pentane yielded a small amount of substances, which according to analyses and infrared spectra seem to be the expected 5-acylaminothiatriazoles. On heating they decompose with gas evolution at a little above room temperature and are transformed into products (probably polymeric) which do not melt below 300°C and which are insoluble in all the common solvents.

The *o*-alkoxyphenyl-1,2,3,4-thiatriazoles (Table 2) were prepared from carboxymethyl *o*-alkoxydithiobenzoates by a similar procedure as described for 5-phenyl-1,2,3,4-thiatriazole[2] and were recrystallised from benzene. The yield of crude products was 70—90 %, but there was about 50 % loss during recrystallisation.

All the thiatriazoles listed in the tables form colourless well-developed crystals. The N-thiatriazolylglycine ester turned yellow in a few days at room temperature due to slight decomposition. 5-Cyclohexyl-amino-1,2,3,4-thiatriazole attained a pink colour without perceptible decomposition.

Some of the thiosemicarbazides used here are new and will be described in a forthcoming paper.

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