Fused Imidazoles: A Novel Synthesis of Imidazo[1,2-*b*][1,2,4]triazole and Imidazo[5,1-*f*]-[1,2,4]triazine Derivatives

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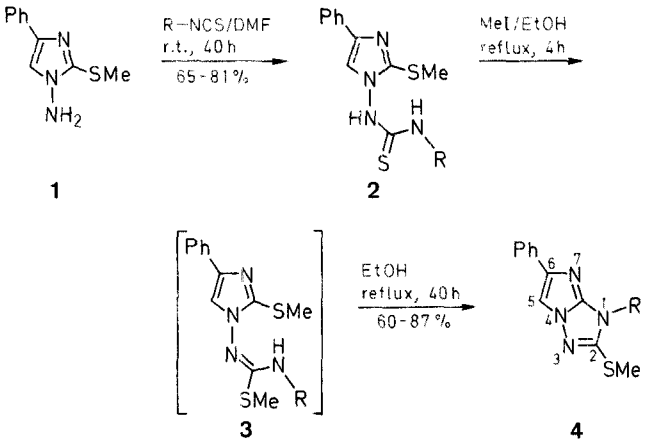
The reaction of 1-amino-2-methylthio-4-phenylimidazole with isothiocyanates, followed by treatment with methyl iodide and heating in ethanol affords 1,6-disubstituted 2-methylthio-1*H*-imidazo[1,2-*b*][1,2,4]triazoles. Starting from the same aminoimidazole, a sequence consisting of *N*-phosphoranylidenation with triphenylphosphine dibromide, replacement of the phosphoranylidene group by an α-chlorobenzylidene group by reaction with benzoyl chlorides, Cl/N_3 exchange with sodium azide, and reaction of the resultant *N*-(α-azidobenzyl) derivate with triphenylphosphine affords the *N*-[α-(triphenylphoranylidenamino)benzyl] derivatives which, on reaction with isocyanates are converted into 2,4,5,7-tetrasubstituted imidazo[5,1-*f*][1,2,4]triazines.

As part of an investigation on the synthesis of fused heterocycles from *N*-aminoheterocyles,[1] in particular, of bridgehead-nitrogen heterocycles containing the imidazo moiety, we recently reported the synthesis of imidazo[1,2-*b*][1,2,4]triazoles[2] and imidazo[1,5-*a*]benzimidazoles.[3] We now describe new general methods for the preparation of some derivatives of the imidazo[1,2-*b*][1,2,4]triazole ring system and of the otherwise not readily available imidazo[5,1-*f*][1,2,4]triazine ring system.

The methods hitherto reported for the preparation of imidazo[1,2-*b*][1,2,4]triazoles either use imidazole derivatives as starting materials (e.g., cyclodehydration of 2-amino-4-arylimidazoles[4]) or start from derivatives of the 1,2,4-triazole ring (e.g., ring closure of 1-phenacyl-5-amino-1,2,4-triazole[5,6]).

Much attention has been focused on imidazo[5,1-*f*][1,2,4]triazines as bronchodilators,[7] as antivirial agents,[8] and as adenosine isosteres.[9] The methods described so far for the preparation of some representative derivatives of this ring system involve cyclization of 3-amino-6-[1-(acylamino)alkyl][1,2,4]triazin-5-ones;[7,10] reaction of β-dicarbonyl compounds with diazenedicarboxamide,[11] or reaction of 6-[(triphenylphosphoranylidene)amino]uracil with diethyl diazenedicarboxylate.[12]

Our approach to imidazo[1,2-*b*][1,2,4]triazoles **4** (Scheme **A**) is based on the reaction of 1-amino-2-methylthioimidazole (**1**) with isothiocyanates to give (N-heteroaryl)thioureas **2** which undergo *S*-methylation to **3** and subsequently, on heating, intramolecular cyclocondensation to give the desired products **4** (Table 1). Compounds **1** are obtained from 4-methoxybenzaldehyde thiosemicarbazone via *S*-methylation, *N*-phenacylation with phenacyl bromide, and hydrazinolysis.[13]



1 2 3 4

2, 3, 4	R	2, 3, 4	R
a	Me	d	4-ClC_6H_4
b	$PhCH_2$	e	4-$CH_3C_6H_4$
c	Ph	f	4-$MeOC_6H_4$

Scheme A

In the sequence of Scheme **A** it is not necessary to isolate the intermediates **3**; these can be submitted to the next step after evaporation of the solvent from the reaction mixture. Only in one case (**3e**) was the intermediate isolated as a crystalline compound in 92% yield.

The structure **4** is corroborated by microanalyses, by the mass spectra, which show the expected molecular ion peaks and peaks for $[M^+ - SCH_3]$, [R – NC], [R], and [Ph – C≡CH], and by the ^{1}H-NMR spectra in which the characteristic chemical shift of the *S*-methyl group is found at $\delta = 2.67–2.77$.

Our preparation of imidazo[5,1-*f*][1,2,4]triazines **10** (Scheme **B**) is based on the reaction of iminophosphoranes **8** with isocyanates. We have previously reported[14] that imidoyl chlorides **6** (readily available from iminophosphorane **5** and aroyl chlorides) undergo thermal cyclization to give the corresponding imidazo[1,2-*b*][1,3,4]thiadiazoles. We have now found now that compounds **6** react with sodium azide in

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Table 1. Thioureas **2** and Imidazo[1,2-*b*][1,2,4]Triazoles **4** Prepared

Product	Yield[a] (%)	mp (°C)[b] solvent	Molecular Formula[c]	MS (70 eV)[d] *m/z* (%)	IR (Nujol)[e] ν (cm^{-1})	^{1}H-NMR (solvent/TMS)[f,g] δ, J (Hz)
2a	65	205–206 (MeCN)	$C_{12}H_{14}N_4S_2$ (278.4)	278 (M^+, 2), 222 (14), 190 (54), 189 (19), 157 (100), 148 (17), 132 (10), 121 (11), 117 (66), 103 (39), 102 (36), 90 (33), 77 (25)	3302, 3167, 1557, 1512, 1244, 1113, 1051, 741, 696	2.57 (s, 3H); 2.89 (d, 3H, J = 4); 7.21–7.80 (m, 6H); 8.13 (s, 1H); 10.66 (s, 1H)
2b	81	175–177 (EtOH)	$C_{18}H_{18}N_4S_2$ (354.5)	354 (M^+, 2), 222 (10), 190 (43), 189 (10), 157 (52), 149 (8), 132 (14), 117 (28), 103 (14), 102 (11), 91 (100), 77 (20)	3281, 3171, 1539, 1505, 1157, 951, 793, 731, 698	2.67 (s, 3H); 4.82 (d, 2H, J = 6); 7.22–8.07 (m, 11H); 8.90 (s, 1H); 10.97 (s, 1H)
2c	75	146–148 (EtOH)	$C_{17}H_{16}N_4S_2$ (340.5)	340 (M^+, 2), 338 (11), 292 (13), 265 (14), 205 (16), 190 (54), 189 (15), 157 (70), 147 (18), 132 (14), 118 (20), 117 (94), 116 (30), 104 (59), 103 (91), 102 (84), 93 (70), 90 (33), 77 (100)	3234, 3166, 1597, 1540, 1228, 1118, 738, 696	2.67 (s, 3H); 7.17–8.10 (m, 11H); 10.36 (s, 1H); 10.99 (s, 1H)
2d	68	160 (Et_2O/CH_2Cl_2)	$C_{17}H_{15}ClN_4S_2$ (374.2)	376 (M^+ + 2, 6), 374 (M^+, 18), 372 (41), 326 (23), 309 (25), 299 (56), 232 (37), 190 (71), 189 (18), 157 (79), 147 (36), 137 (44), 127 (22), 117 (60), 116 (31), 104 (30), 103 (80), 102 (100), 77 (31)	3251, 3200, 1591, 1540, 1214, 1113, 1092, 1015, 827, 727, 692	2.60 (s, 3H); 7.18–7.87 (m, 10H); 10.30 (s, 1H); 11.00 (s, 1H)
2e	78	158–160 (EtOH)	$C_{18}H_{18}N_4S_2$ (354.5)	354 (M^+, 2), 205 (25), 190 (51), 189 (13), 157 (54), 149 (100), 132 (40), 117 (39), 107 (45), 106 (68), 104 (29), 103 (22), 102 (18), 91 (99), 77 (37)	3271, 3204, 1591, 1541, 1223, 1113, 814, 731, 692	2.33 (s, 3H); 2.70 (s, 3H); 7.07–8.20 (m, 10H); 10.33 (s, 1H); 11.00 (s, 1H)
2f	72	162–164 (Et_2O/CH_2Cl_2)	$C_{18}H_{18}N_4OS_2$ (370.5)	370 (M^+, 2), 205 (34), 190 (57), 189 (17), 165 (100), 157 (62), 148 (28), 133 (29), 122 (60), 117 (35), 108 (42), 104 (20), 103 (19), 102 (16), 77 (17)	3290, 3143, 1546, 1512, 1251, 1229, 1127, 1036, 826, 747, 696	2.58 (s, 3H); 3.75 (s, 3H); 6.99–7.83 (m, 10H); 9.96 (s, 1H); 10.67 (s, 1H)
4a	69	212 (CH_2Cl_2)	$C_{12}H_{12}N_4S$ (244.3)	244 (M^+, 92), 197 (99), 171 (10), 144 (15), 128 (42), 127 (21), 104 (15), 103 (100), 102 (10), 77 (15)	1676, 1659, 1325, 1302, 1149, 1104, 849, 775, 735, 696	2.74 (s, 3H); 3.71 (s, 3H); 7.38–8.51 (m, 6H)
4b	60	195–197 (CH_2Cl_2)	$C_{18}H_{16}N_4S$ (320.4)	320 (M^+, 30), 273 (10), 229 (15), 128 (11), 117 (10), 104 (8), 103 (8), 102 (10), 91 (100), 77 (15)	1657, 1526, 1447, 1393, 1198, 1105, 945, 783, 744, 706, 698	2.77 (s, 3H); 5.70 (s, 2H); 7.03–8.22 (m, 11H)
4c	72	156–158 (EtOH)	$C_{17}H_{14}N_4S$ (306.4)	306 (M^+, 35), 259 (13), 233 (27), 193 (10), 129 (15), 117 (8), 104 (15), 103 (100), 102 (8), 77 (31)	1659, 1607, 1593, 1578, 1505, 1252, 1175, 1072, 961, 764, 716, 700	2.70 (s, 3H); 7.23–8.10 (m, 11H)
4d	74	161–163 (EtOH)	$C_{17}H_{13}ClN_4S$ (340.8)	342 (M^+ + 2, 4), 340 (M^+, 12), 293 (8), 232 (35), 137 (100), 129 (14), 111 (18), 104 (5), 103 (27), 102 (41), 77 (14)	1605, 1587, 1574, 1503, 1254, 1175, 1092, 826, 772, 712, 698	2.70 (s, 3H); 7.28–8.15 (m, 10H)
4e	87	120–122 (EtOH)	$C_{18}H_{16}N_4S$ (320.4)	320 (M^+, 75), 273 (27), 247 (78), 207 (18), 129 (11), 118 (12), 117 (100), 116 (58), 104 (10), 103 (19), 102 (10), 91 (26), 77 (15)	1609, 1593, 1579, 1520, 1259, 1174, 1068, 1030, 959, 814, 764, 712, 687	2.47 (s, 3H); 2.67 (s, 3H); 7.23–8.03 (m, 10H)
4f	72	169–171 (MeCN)	$C_{18}H_{16}N_4OS$ (336.4)	336 (M^+, 54), 289 (13), 263 (43), 248 (19), 133 (100), 118 (13), 117 (8), 116 (15), 104 (12), 103 (56), 102 (10), 77 (15)	1605, 1593, 1580, 1520, 1300, 1258, 1248, 1177, 1032, 831, 770, 712, 696	2.67 (s, 3H); 3.90 (s, 3H); 7.00–8.07 (m, 10H)

[a] Yield of isolated pure product.
[b] Uncorrected.
[c] Satisfactory microanalyses: C ± 0.27, H ± 0.26, N ± 0.22.
[d] Recorded on a Hewlett-Packard 5993C instrument.
[e] Recorded on a Nicolet FT 5DX spectrophotometer.
[f] Recorded at 80 MHz on a Varian FT-80 spectrometer.
[g] Solvents: DMSO-d_6 (**2a–f**), $CDCl_3$ (**4a, c–f**), $CDCl_3/CF_3CO_2D$ (**4b**).

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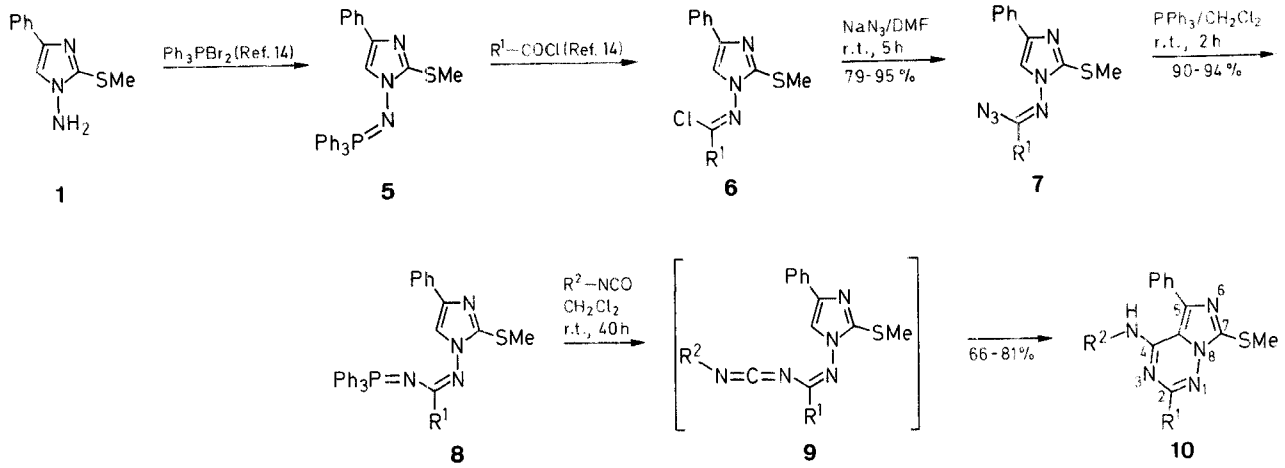

7, 8	R^1	10	R^1	R^2
a	4-$CH_3C_6H_4$	a	4-$CH_3C_6H_4$	Me
b	4-$MeOC_6H_4$	b	4-$CH_3C_6H_4$	4-$CH_3C_6H_4$
		c	4-$CH_3C_6H_4$	3-$CH_3C_6H_4$
		d	4-$CH_3C_6H_4$	4-ClC_6H_4
		e	4-$CH_3C_6H_4$	3-$MeOC_6H_4$
		f	4-$CH_3C_6H_4$	1-naphthyl
		g	4-$MeOC_6H_4$	4-$CH_3C_6H_4$

Scheme **B**

Table 2. *N*-Imidazolylimidoyl Azides **7** and Iminophosphoranes **8** Prepared

Product	Yield[a] (%)	mp[b] (°C)	Molecular Formula[c]	MS (70 eV)[d] m/z (%)	IR (Nujol)[e] ν (cm^{-1})	^{1}H-NMR ($CDCl_3$/TMS)[f] δ	^{13}C-NMR ($CDCl_3$/TMS)[g] δ
7a	79	106–107	$C_{18}H_{16}N_6S$ (348.4)	320 ($M^+ - N_2$, 23), 222 (57), 190 (43), 189 (22), 157 (70), 131 (22), 129 (24), 117 (74), 116 (36), 104 (65), 103 (41), 102 (38), 91 (100), 77 (67)	2118 (N_3)	2.42 (s, 3H); 2.69 (s, 3H); 7.27–7.41 (m, 5H); 7.63–7.85 (m, 4H); 8.00 (s, 1H)	14.70 (SCH_3); 21.52 ($ArCH_3$); 114.19, 125.10, 127.21, 128.05, 128.58, 129.80, 130.43, 132.06, 134.05, 140.60, 142.68, 145.42
7b	95	108–110	$C_{18}H_{16}N_6OS$ (364.4)	336 ($M^+ - N_2$, 15), 254 (23), 239 (32), 190 (48), 157 (93), 148 (34), 133 (57), 129 (27), 121 (27), 117 (88), 104 (64), 103 (89), 102 (43), 91 (28), 77 (100)	2135 (N_3)	2.68 (s, 3H); 3.85 (s, 3H); 6.89–7.50 (m, 5H); 7.75–7.79 (m, 5H)	
8a	94	196–197	$C_{36}H_{31}N_4PS$ (582.7)	582 (M^+, 5), 535 (14), 262 (13), 185 (30), 183 (70), 117 (24), 108 (100), 107 (24), 103 (31), 102 (64), 91 (10), 77 (18)	1506 (C=C); 1439 (N=P)	2.38 (s, 3H); 2.58 (s, 3H); 6.70–6.74 (m, 2H); 7.13–7.48 (m, 20H); 7.73–7.84 (m, 3H)	15.83 (SCH_3); 21.16 ($ArCH_3$); 116.63, 124.47, 125.73, 128.13, 128.20, 128.35, 128.48, 128.73, 130.61, 132.00, 132.06, 132.48, 132.69, 133.31, 135.55, 135.65, 138.58, 138.71, 140.54
8b	90	155–157	$C_{36}H_{31}N_4OPS$ (598.7)	598 (M^+, 5), 551 (14), 409 (19), 262 (31), 185 (38), 184 (22), 183 (98), 133 (48), 116 (16), 108 (100), 103 (27), 102 (83), 77 (19)	1506 (C=C); 1440 (N=P)	2.54 (s, 3H); 3.65 (s, 3H); 6.37–6.55 (m, 2H); 7.18–7.55 (m, 20H); 7.65–7.83 (m, 3H)	

[a,b,d,e] See Table 1.
[c] Satisfactory microanalyses: C ±0.18, H ±0.25, N ±0.18.
[f] Recorded at 200 MHz on a Bruker AC-E200 spectrometer.
[g] Recorded at 50 MHz on a Bruker AC-E200 spectrometer.

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dimethylformamide at room temperature to give *N*-imidazolylimidoyl azides **7** as crystalline solids in 79–95% yields (Table 2). The preparation of the desired iminophosphoranes **8** is easily accomplished by the classical Staudinger reaction[15] of azides **7** with triphenylphosphine in dry dichloromethane at room temperature. Iminophosphoranes **8** react with several alkyl and aryl isocyanates in dry dichloromethane at room temperature (36 h) to give triphenylphosphine oxide and the corresponding 2-aryl-

Table 3. Imidazo[5,1-*f*][1,2,4]triazines **10** Prepared

Product	Yield[a] (%)	mp[b] (°C) (CH_3CN)	Molecular Formula[c]	MS (70 eV)[d] *m/z* (%)	IR (Nujol)[e] ν (cm^{-1})	^{1}H-NMR (solvent/TMS)[f,h] δ, *J*(Hz)	^{13}C-NMR ($CDCl_3$/TMS)[g,h] δ
10a	81	233–234	$C_{20}H_{19}N_5S$ (361.5)	361 (M^+, 100), 360 (10), 328 (43), 288 (17), 196 (12), 142 (61), 128 (59), 118 (14), 117 (10), 103 (5), 91 (5), 77 (15)	3347, 1593, 1574, 1562, 1518, 1051, 943, 746, 696	2.41 (s, 3H); 2.79 (s, 3H); 3.18 (d, 3H, *J* = 6); 5.76 (m, 1H); 7.24–8.31 (m, 9H)	14.39 (SCH_3); 21.47 ($PhCH_3$); 27.46 ($NHCH_3$); 111.75 (C-4a); 127.83, 128.48, 128.93, 129.00, 129.26, 133.21, 134.90; 139.25 (C-5); 142.52 (C-7); 154.76 (C-4); 155.73 (C-2)
10b	75	193–194	$C_{25}H_{21}N_5$ (423.5)	423 (M^+, 81), 422 (11), 390 (21), 204 (50), 128 (40), 118 (20), 117 (11), 116 (15), 103 (6), 93 (7), 77 (100)	3395, 1620, 1604, 1586, 1570, 1559, 1522, 1321, 1263, 1177, 1032, 748	2.42 (s, 3H); 2.82 (s, 3H); 7.14 (t, 1H, *J* = 7.4); 7.17–7.75 (m, 12H); 8.24 (d, 2H, *J* = 8.2)	14.29 (SCH_3); 21.55 ($PhCH_3$); 111.16 (C-4a); 120.66, 124.36, 127.82, 129.02, 129.13, 129.18, 129.44, 132.64, 134.42, 134.82, 137.71; 139.74 (C-5); 140.77 (C-7); 151.65 (C-4); 155.64 (C-2)
10c	66	171–173	$C_{26}H_{23}N_5S$ (437.6)	437 (M^+, 100), 436 (13), 404 (31), 364 (11), 218 (43), 128 (38), 118 (19), 117 (10), 116 (15), 103 (10), 92 (10), 91 (82), 77 (10)	3397, 1620, 1587, 1574, 1520, 1499, 1314, 1179, 1113, 964, 959, 748, 690	2.50 (s, 6H); 2.87 (s, 3H); 7.00–7.85 (m, 13H); 8.13 (m, 1H)	14.31 (SCH_3); 21.25 ($ArCH_3$); 21.51 ($ArCH_3$); 109.32; 111.26 (C-4a); 117.92, 121.50, 125.13, 125.26, 126.68, 127.57, 127.87, 128.74, 129.00, 129.20, 129.43, 129.96, 132.77, 133.92, 134.51, 134.90, 138.95; 139.78 (C-5); 148.80 (C-7); 151.75 (C-4); 155.73 (C-2)
10d	71	170–171	$C_{25}H_{20}ClN_5S$ (458.0)	459 ($M^+ + 2$, 41), 457 (M^+, 100), 426 (10), 424 (30), 386 (4), 384 (12), 240 (21), 238 (63), 216 (3), 214 (13), 203 (27), 176 (10), 147 (14), 129 (27), 128 (74), 127 (29), 118 (45), 116 (25), 111 (59), 103 (24), 91 (24), 77 (49)	3376, 1616, 1522, 1500, 1182, 1091, 1009, 820, 744	2.42 (s, 3H); 2.81 (s, 3H); 7.24–7.84 (m, 11H); 7.99 (s, 1H); 8.18–8.22 (m, 2H)	14.29 (SCH_3); 21.58 ($ArCH_3$); 109.36; 111.09 (C-4a); 121.97, 125.15, 126.72, 127.63, 127.84, 128.79, 129.11, 129.23, 129.53, 130.00, 132.57, 133.89, 134.47, 135.06, 136.34; 140.12 (C-5); 141.00 (C-7); 142.35; 151.66 (C-4); 155.60 (C-2)
10e	77	195–197	$C_{26}H_{23}N_5OS$ (453.6)	453 (M^+, 100), 452 (14), 420 (21), 234 (24), 128 (28), 118 (20), 117 (10), 107 (17), 103 (8), 92 (22), 91 (12), 77 (48)	3405, 1589, 1570, 1551, 1520, 1506, 1200, 1177, 1115, 955, 746, 721, 692	2.41 (s, 3H); 2.80 (s, 3H); 3.83 (s, 3H); 6.77 (dd, 2H); 7.16–7.76 (m, 10H); 8.23–8.27 (m, 2H)	14.28 (SCH_3); 21.50 ($PhCH_3$); 55.36 (OCH_3); 106.49, 110.41; 111.22 (C-4a); 112.60, 127.85, 129.05, 129.11, 129.22, 129.44, 129.67, 132.74, 134.46, 134.93, 138.99; 139.86 (C-5); 140.84 (C-7); 151.77 (C-4); 155.67 (C-2); 160.19
10f	76	224–226	$C_{29}H_{23}N_5S$ (473.6)	473 (M^+, 100), 472 (16), 440 (13), 426 (5), 254 (30), 143 (10), 128 (15), 127 (30), 118 (10), 117 (21), 91 (8), 77 (15)	3406, 1593, 1574, 1553, 1522, 1508, 1500, 1178, 1113, 827, 770, 737, 721, 692	2.43 (s, 3H); 2.95 (s, 3H); 7.15–8.45 (m, 17H)	
10g	66	189–191	$C_{26}H_{23}N_5OS$ (453.6)	453 (M^+, 43), 420 (10), 218 (46), 134 (28), 133 (23), 128 (47), 118 (10), 103 (25), 91 (100), 77 (24)	3392, 1614, 1569, 1518, 1498, 1255, 1170, 1029, 957, 830, 803, 755	2.32 (s, 3H); 2.79 (s, 3H); 3.84 (s, 3H); 6.92–6.97 (m, 2H); 7.12–7.94 (m, 10H); 8.26–8.32 (m, 2H)	14.29 (SCH_3); 20.89 ($PhCH_3$); 55.48 (OCH_3); 109.27; 111.18 (C-4a); 113.70, 114.61, 120.80, 125.05, 128.04, 128.28, 128.70, 128.88, 129.14, 129.37, 129.45, 129.52, 134.12, 134.54, 133.78; 139.10 (C-5); 139.65 (C-7); 151.54 (C-4); 155.40 (C-2); 161.67

[a,b,d,e] See Table 1.

[c] Satisfactory microanalyses: C ±0.27, H ±0.26, N ±0.27.

[f,g] See Table 2.

[h] Solvents: $CDCl_3$ **(10a, b, g)**, DMSO-d_6 **(10c–f)**.

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4-arylamino-7-methylthio-5-phenylimidazo[5,1-*f*][1,2,4]triazines **10** as crystalline solids in 66–81% yields (Table 2).

We assume the mechanism of the conversion **8** → **10** to involve initial aza-Wittig reaction between the iminophosphorane **8** and the isocyanate to give a carbodiimide **9** as a highly reactive intermediate, which easily undergoes ring closure by attack of the imidazole C-5 atom ring on the sp-hybridized C-atom of the carbodiimide moiety followed by a 1,3-proton shift to give **10**. Although a heterocyclization reaction based on the reaction of carbodiimide with the NH group of the imidazole ring has been reported,[3] the reaction described here is, to our knowledge, the first example of the annulation of a 1,2,4-triazine ring to a preformed imidazole ring with formation of a C–C bond between a carbodiimide moiety and a ring C-atom of the imidazole moiety. Thus, the results presented here confirm that the not readily available imidazo[5,1-*f*][1,2,4]triazine ring system may be prepared under mild conditions from readily available starting materials.

Determination of the structure of compounds **10** was accomplished on the basis of microanalyses and spectral data. Salient features of the mass, IR, ^{1}H-NMR and ^{13}C-NMR spectra are given in Table 3. The mass spectra show the expected molecular ion peaks as the base peaks, except for compound **10b** (81%) and **10g** (43%); peaks are also found at m/z = $[M^+ - 1]$, $[M^+ - 33]$, $[R^1 - CN]$, and 128. In the ^{1}H-NMR spectra, the characteristic chemical shift of the *S*-methyl group is found at δ = 2.76–2.95. In the ^{13}C-NMR spectra, the signal of the SCH_3 is characteristically found at δ = 14.28–14.39 and the other signals of the different carbons are in good agreement with previous reported values.[16]

N'-Alkyl(aryl)-N-(2-methylthioimidazolyl)thioureas 2; General Procedure:
To a well stirred solution of 1-amino-2-methylthio-4-phenylimidazole[13] (**1**, 3.075 g, 15 mmol) in dry DMF (25 mL) is added the appropriate isothiocyanate (15 mmol). The resultant solution is stirred at room temperature for 36 h, then poured into cold H_2O (20 mL). The precipitated solid is isolated by suction, air-dried, and recrystallized from an appropriate solvent to give the product **2** (Table 1).

1-Substituted 2-Methylthio-6-phenyl-1*H*-imidazo[1,2-*b*][1,2,4]triazoles 4; General Procedure:
To a solution of the appropriate thiourea **2** (10 mmol) in EtOH (20 mL) is added MeI (2.84 g, 20 mmol). The solution is stirred at reflux temperature for 4 h, then cooled, and the solvent is removed under reduced pressure. The residue is washed with 10% Na_2CO_3 solution (20 mL), the resultant solid is dissolved in EtOH (25 mL), and this solution is heated to reflux for 24 h. After cooling, the solution is concentrated to dryness, and the residual material is recrystallized from an appropriate solvent to give the product **4** (Table 1).

Methyl N-(4-Methylphenyl)-N'-(2-methylthio-4-phenylimidazol-1-yl)carbamimidothioate (3e):
To a solution of the thiourea **2e** (1.77 g, 5 mmol) in EtOH (25 mL) is added MeI (2.84 g, 20 mmol) and this solution is stirred at reflux temperature for 4 h. After cooling, the solution is concentrated to dryness, and the residual material is slurried with 10% Na_2CO_3 solution (20 mL), isolated by suction, and recrystallized from CH_2Cl_2/hexane (1:1, v/v) to give **3e**; yield: 1.69 g (92%); yellow prisms, mp 133–135°C.

$C_{19}H_{20}N_4S_2$	calc.	C 61.93	H 5.47	N 15.20
(368.5)	found	61.80	5.64	15.07

MS (EI, 70 eV): m/z = 368 (M^+, 34%); 321 (18); 190 (42); 178 (20); 164 (23); 157 (36); 132 (21); 117 (20); 86 (64); 84 (100); 77 (100).

IR (Nujol): ν = 3254 (NH); 1522, 1119, 814, 754, 692 cm^{-1}.

^{1}H-NMR ($CDCl_3$/TMS): δ = 2.37 (s, 3H); 2.53 (s, 3H); 2.63 (s, 3H); 7.15–7.92 (m, 11H).

1-(α-Azidobenzylideneamino)-2-methylthio-4-phenylimidazoles 7; General Procedure:
To a well stirred solution of the appropriate imidoyl chloride[14] **6** (5 mmol) in dry DMF (20 mL) is added NaN_3 (0.65 g, 10 mmol). The resultant solution is stirred at room temperature for 5 h whereupon it is poured into cold H_2O (20 mL). The solid material is isolated by suction, air-dried, and recrystallized from Et_2O to give the product **7** (Table 2).

2-Methylthio-4-phenyl-1-[α-(triphenylphosphoranylidenamino)benzylidenamino]imidazoles 8; General Procedure:
A solution of the appropriate imidoyl azide **7** (5 mmol) in dry CH_2Cl_2 (20 mL) is added dropwise, under N_2 at room temperature, to a well stirred solution of triphenylphosphane (1.32 g, 5 mmol) in dry CH_2Cl_2 (30 mL). The mixture is stirred at room temperature for 2 h whereupon the solvent is removed under reduced pressure. The residual material is slurried with hexane (10 mL), isolated by suction, and recrystallized from benzene to give the product **8** (Table 2).

2-Aryl-4-arylamino-(or methylamino)-5-phenyl-7-methylthioimidazo[5,1-*f*][1,2,4]triazines 10; General Procedure:
To a solution of the appropriate iminophosphorane **8** (5 mmol) in dry CH_2Cl_2 (50 mL), an aryl isocyanate (or methyl isocyanate) (5 mmol) is added. The mixture is stirred at room temperature for 40 h whereupon the solvent is removed under reduced pressure. The residual material is stirred with cold EtOH (10 mol) for 30 min and the separated solid is isolated by suction and recrystallized from MeCN to give the product **10** as crystalline solid (Table 3).

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